NATURAL HISTORY OF OSTEOCHONDROSIS TIBIAE (Mb. BLOUNT)

by

MOHAMMED ZAYER

LUND 1973

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MOHAMMED ZAYER

LUND 1973

Translated from the Swedish

by

L. JAMES BROWN

Lagerblads
NYA LAGERBLADS TRYCKERI AB
KARLSHAMN 1973

To my parents and my home-town Amarah, Iraq

4 years 6 months old (Case No. 45).
The infantile type of Mb. Blount is usually bilateral.

13 years old (Case No. 28).
The juvenile type of Mb. Blount is more often unilateral.

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I. Introduction

Until the beginning of this century bow-legs in childhood were mostly ascribed to rickets (Blount 1941, Leonard and Cohen 1946, Jacobsson 1949, Kite 1954, Herrara 1959, Michail et al 1959). However, the marked decline in the frequency of rickets has not been accompanied by a proportional reduction in the frequency of bow-legs. It was then gradually realised that bow-legs could be explained also on grounds other than rickets and that one of the many causes of the condition was a growth disturbance of the medial aspect of the proximal tibia (Blount 1937). This disease manifests itself as a growth disorder involving the *metaphysis,* the *physis* (growth plate), and the *epiphysis* of the postero-medial part of proximal tibia. This results in angulation of the legs at the level of the knee giving an appearance of curved legs, even though neither the tibial diaphysis nor the femur is pathologically curved.

Since Erlacher (1922) published the first case, various theories of the pathogenesis of the condition have been advanced, but none has been generally accepted. The following factors have been suggested by different authors: a type of cartilaginous exostosis (Mau 1924), aseptic necrosis (Langenskiöld 1928), a growth disturbance (Nilsonne 1929), infection (Lülsdorf 1931), endocrine disorder (Pitzen and Marquart 1939), abnormal pressure due to weight-bearing on the medial aspect of proximal tibia and racial factors (Bateson 1966), genetic factors (Sevastikoglou and Eriksson 1967). Also, knowledge of the natural history of the disease and of its clinical and radiographic characteristics is relatively scanty, presumably because the condition is not well known and is often confused with other types of genu varum. This vagueness of knowledge of the pathogenesis of the disease is reflected in the large number of names under which it has been described, for example: *Tibia vara* or *Osteochondrosis Deformans Tibiae* (Blount 1937, Langenskiöld 1952), *Blount's Disease* (Medbö 1964, Tachdjian 1972), *Erlacher-Blount's Disease* (Michail et al 1959, Sazonova 1970), *Blount-Barber's Syndrome* (Rojas et al 1960), *Non-rachitic Bow-leg* (Barber 1942, Bateson 1966), *Osteochondropathia Deformans* (Rall 1929), *Dyschondroplastic Bowlegs* (Sloane et al 1936), or *Familial Infantile Osteochondrosis Deformans Tibiae — Idiopathic Tibia Vara* (Sevastikoglou and Eriksson 1967).

With the etiology of the condition unknown, treatment of Mb. Blount varies widely. Conservative treatment, osteotomy or epiphyseodesis have been performed, irrespective of age, degree of deformity or stage of the disease. It is indeed difficult to gather from the literature how this disease should best be treated. Published series are small and the treatment given and the results obtained are often incompletely described.

With this situation in mind it was decided to undertake the present investigation, which comprised:

1. Collection of a Swedish material of osteochondrosis tibiae (Mb. Blount) — 131 knees in 85 patients.
2. Classification of this material on clinical and radiographic grounds.
3. Description of the natural history of the condition with an attempt to evaluate possible effects of the treatment.

Table 1: Genu Varum in children.

I. PHYSIOLOGIC GENU VARUM, page 15

II. PATHOLOGIC GENU VARUM

A. Congenital

1. Hypochondroplasia
2. Chondro-osteodystrophy
3. Osteogenesis imperfecta
4. Prenatal bowing (Caffey 1947), page 16

B. Trauma, page 19

1. Accident
2. Operation, Fig. 6 a
3. Radiotherapy, Fig. 6 b

C. Infection

1. Septic osteomyelitis
2. Tuberculosis

D. Metabolic

1. Rickets, page 16, Fig. 4
2. Hyophosphatemic (vitamin-D refractory) rickets, page 17, Fig. 5
3. Scurvy

E. Tumour

F. Mb. Blount, page 11

II. Differential Diagnosis of Mb. Blount

There are many causes of genu varum (Table 1). The main problem in establishing a diagnosis of MB. BLOUNT is encountered in excluding PHYSIOLOGIC GENU VARUM, PRENATAL GENU VARUM, RICKETS and HYPOPHOSPHATEMIC (VITAMIN-D-REFRACTORY) RICKETS, and POST-TRAUMATIC GENU VARUM.

Mb. Blount

Blount (1937) collected 15 previously published cases, added 13 of his own and gave a clinical, histologic, and radiographic description of the condition which he called Tibia Vara or Osteochondrosis Deformans Tibiae. Blount described two different *types: Infantile* and *Adolescent*. In the subsequent presentation, the designation "*Juvenile*" has been used instead of "Adolescent", since adolescence designates the period of physical and physiological development from the onset of puberty to maturity, and the type of Mb. Blount under discussion often starts before puberty.

THE INFANTILE TYPE

The infantile type of Mb. Blount is usually bilateral and generally discovered when the child begins to walk. Pain is usually absent, a bulbous enlargement of the medial condyle of the tibia is palpable, internal rotation of the tibia on the femur is a constant finding, genu recurvatum and flatfoot are present, and a minimal shortening of the leg is noticed in unilateral cases.

According to Blount (1937), the *radiographic examination* shows abrupt angulation just below the proximal tibial epiphysis which is wedge-shaped, while the medial metaphysis is beaklike; within the beak cartilage islands are present (Fig. 1). Langenskiöld (1952) has subdivided the radiographic findings into six progressive stages (Fig. 2). Stage I (2—3 years) is characterised by an irregular metaphysis with a medial beak. In Stage II (2½—4 years) there is a depression in the beak, filled with cartilage. In the side view, the beak causes a dense curved line, which is seen in all stages. The medial part of the bony epiphysis is still more wedge-shaped and poorly

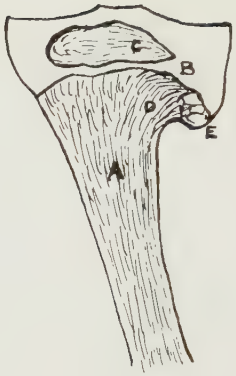


FIG. 26-B

Case 1. Aged three and one-half years. Tracing from the roentgenogram with the cartilage restored. *A:* shaft angulated; *B:* widened epiphyseal line; *C:* wedge-shaped epiphysis; *D:* beaklike metaphysis; *E:* cartilage islands.

Fig. 1. Reproduced from Blount (1937).

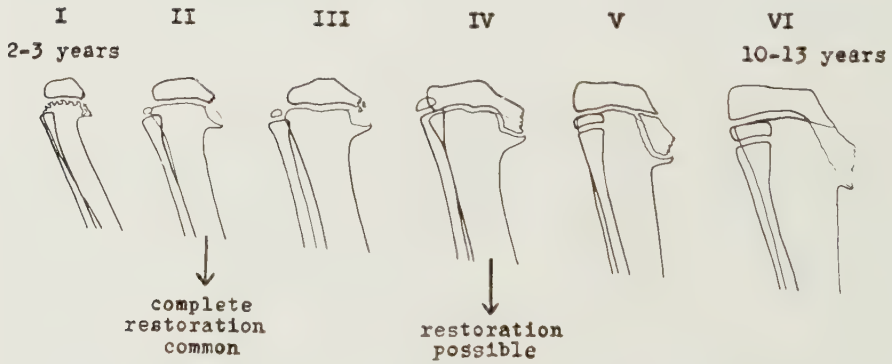


Fig. 5. Diagram showing the roentgenological changes seen in the infantile type and their development with increasing age (cf. Table II on page 10 and text on pages 8—12). Six stages.

Fig. 2. Reproduced from Langenskiöld (1952).

developed. Stage III (4—6 years) is characterized by deepening of the cartilage-filled depression in the metaphyseal beak, with the radiolucent area giving the appearance of a "step" in the metaphysis. The medial part of the bony epiphysis is still wedge-shaped but less distinct. In Stage IV

(5—10 years) the step in the metaphysis increases in depth, and the bony epiphysis occupies the depression; separate centers of ossification in the cartilage may unite. In Stage V (9—11 years) the medial part of the epiphysis forms an irregularly bordered triangle fragment between two layers of a "partially double epiphyseal plate". The bony epiphysis and the corresponding articular surface are greatly deformed, causing excessive laxity. The deformity is now irreparable. In Stage VI (10—13 years) finally, the medial part of the epiphyseal plate has ossified.

Evensen and Steffensen (1957) found by *arthrography* in one patient, aged 7 years, that the medial third of the joint sloped steeply downwards and that the medial meniscus was abnormally large. Langenskiöld and Riska (1964) showed in a case of Stage IV (Fig. 3) that the lack of epiphyseal bone may be compensated by a thick articular cartilage and a large medial meniscus. Sevastikoglou and Eriksson (1967) reported 2 cases with normal arthrographic findings and disagreed with Evensen and Steffensen except in cases with prolonged development.

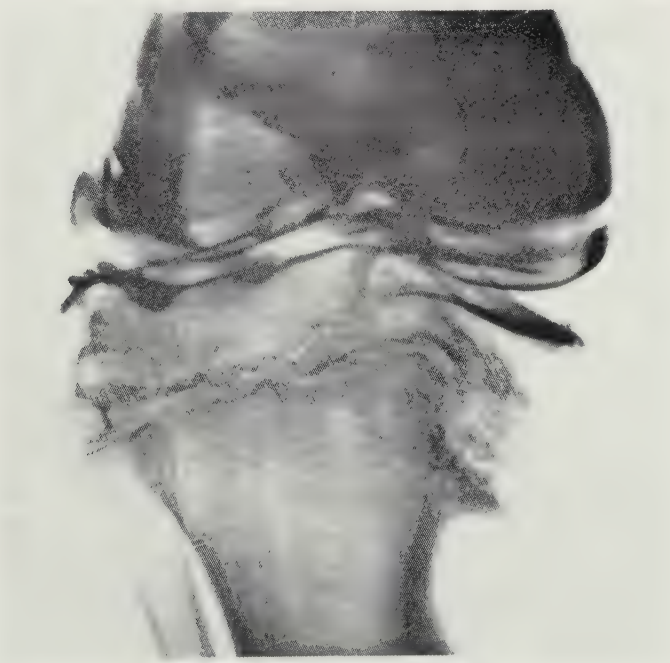


FIG. 12

At ten years of age. Stage IV: sloping of the medial part of the tibial epiphysis. An arthrogram shows thick articular cartilage on the medial tibial condyle and a large medial meniscus. There is very slight ligamentous laxity in this joint.

Fig. 3. Reproduced from Langenskiöld and Riska (1964).

Blount (1937) concluded from examination of a *biopsy specimen* from the beak that there is marked distortion of bone trabeculae. At the point of cartilage junction there were spicules of bone on the outer surface of the cartilage which had partly softened, and granulation tissue had invaded some of the softened areas, while other areas appeared as holes in the cartilage. There were islands of cartilage and calcium deposits. Langenskiöld (1952) in 10 infantile cases, and Golding and Mc Neil Smith (1963) in 6 infantile cases, have shown that the pathologic changes are principally located in the zone of resting cartilage in the metaphyseal beak. There are islands of densely packed cells showing an abnormal degree of hypertrophy, islands of almost acellular fibrous cartilage, and abnormally large groups of capillary vessels. No findings suggest the occurence of an aseptic necrosis.

THE JUVENILE TYPE

The juvenile type of Mb. Blount is more often unilateral and starts just before puberty. Pain may be present in the knee or foot of the affected leg. The degree of varus deformity is not as severe as in the infantile type and usually does not exceed 20°. Shortening of the leg is quite apparent — as much as 2 cm. Excessive internal rotation of the tibia and flat feet are not usual in the juvenile type.

According to Blount (1937), *radiographic examination* shows an arrest of epiphyseal growth rather than a dysplasia. There is irregularity of the contour of the proximal tibial epiphyseal line medially with abrupt angulation at the metaphysis with the apex laterally. Blount concluded that the radiographic changes are like those of coxa plana and similar to those of chondrodysplasia, but quite different from those of rickets. Langenskiöld (1952) noticed that the radiographic shape of the bony epiphysis is normal and that there is no step in the epiphyseal line. Rather, a narrowing of the middle part of the medial half of the epiphyseal plate is a characteristic feature. On both sides of this narrow portion there is an increased density of the bone. De Moraes and Perricone (1959) noticed that the medial half of the tibial epiphysis is reduced in height, while the outer half is often normal. Sometimes a "fish mouth" appearance can be seen, so that the lower lip resembles an exostosis with small areas of thinning giving it the appearance of a bracket. Later, in adults, the medial half of the tibial epiphysis slopes steeply downwards and inwards. The lateral view often shows a curved line as in the infantile type (Lamy and Weissman 1946, De Moraes and Perricone 1959).

The *histo-pathology* in the juvenile type has been studied by Pitzen and Marquart (1939). They found irregularity in the growth zone and

concluded that this appearance was identical with the infantile type described by Blount (1937). Therefore they did not accept that there are two types of the disease, a view which has been shared by other authors (Morris 1948, Iannaccone and Pieragostini 1966). However, as will be shown in the analysis of the cases studied here, the difference in sex distribution and in incidence of bilaterality clearly establishes the identy of the two types of Mb. Blount.

Some authors have presented cases which had not been examined radiographically or even clinically until they had reached adult age (Blount 1937 — Case 4; Pitzen and Marquart 1939 — Case 5; Aberle and Horstenegg 1956 — Cases 4 and 5; De Moraes and Perricone 1959 — Cases 9, 14, 22, 25 and 26). In such cases it is impossible to distinguish radiographically between the final stages of the infantile and the juvenile types. Age at onset, however, usually provides a definite clue in this respect; in addition, the two types differ in sex distribution and frequency of bilateral involvement.

A search of the literature revealed 418 cases described as Mb. Blount (see Discussion and Conclusion, page 72).

The diagnosis of Mb Blount was accepted for inclusion in the present study, only in cases with genu varum in whom radiographic changes of growth disturbances were confined to the postero-medio-proximal part of the tibia. Presence of additional clinical or radiographic abnormalities were not accepted.

Physiologic Genu Varum

Most authors agree that in the newborn the legs are normally not straight but bent in a gentle varus curve which disappears within the first few years of life and may instead be followed by mild genu valgum, which disappears after the age of 6 years. Opinions disagree only as to the age at which this physiologic genu varum disappears (Böhm 1928, 1930, Bragard 1932, Forest 1949, Gordon 1961, Rennotte 1968, and Bauer 1970). A physiologic transition from a flexion deformity to slight recurvation (Blount 1941), or a medial torsion of the tibia (Nachlas 1934, Howorth 1959, Mercer and Duthie 1964, Blount 1966, and Turek 1967) has also been described.

The *cause* of these physiologic changes in newborns and children has been ascribed to various factors, such as muscular imbalance, intrauterine position, knee-chest-position during sleep, wearing of napkins, obesity, racial factors. Blount (1966) referred Pauwel's hypothesis (1957) that weight bearing with mild bow-leg probably stimulates growth of the medial side of the proximal tibia.

Radiographically physiologic genu varum shows a medial and dorsal beaking of the femoral and tibial metaphyses, thickening of the medial and dorsal cortical walls of the tibiae, and a certain reduction in the size of the distal femoral epiphyseal ossification center. The medial halves of the tibial and femoral epiphyseal ossification centers are often wedge-shaped and taper to point medially. These changes have been interpreted as a stress phenomenon (Caffey, 1967) due to uneven weight bearing. This form of physiologic genu varum disappears spontaneously and therefore requires no treatment (see Case report No. 1).

Golding and McNeil-Smith (1963), Blount (1966) and Lloyd-Roberts (1967) found that the early stages of Mb. Blount may be indistinguishable from physiologic genu varum. However, the diagnosis can be settled by continued roentgen control.

Prenatal Genu Varum

According to Caffey (1947), prenatal bowing of the legs is present already at birth and may therefore be difficult to distinguish from physiologic genu varum. But careful inquiry into the patient's history and clinical examination will often reveal "dimples" situated over the summits of the curvatures in the deformed bones. This prenatal bowing tends to regress soon after birth, but may sometimes persist for as long as 7 years and it may then be difficult to differentiate between this type of bow-legs and bow-legs due to rickets and Mb. Blount. This prenatal genu varum has been ascribed to abnormal position of the foetus in uterus (Caffey 1947, 1967, Gordon 1961, and Aegerter-Kirkpatrick 1963). Radiography shows a typical, markedly thickened cortical wall of the inner side of the tibia with thinning of the outer side. The fibula is S-shaped and the cortical segment on the inner side of each curve is thickened. According to Blount (1941), treatment with osteotomy is almost invariably followed by disastrous results because the osteotomy fails to unite, and in spite of subsequent bone grafts a permanent nonunion may persist until after puberty.

Rickets

Active rickets is easy to distinguish from Mb. Blount by the presence of wide-spread clinical and radiographic changes; in addition chemical abnormalities are usually identified. However, in healed rickets the varus deformity of the proximal tibia may persist (Fig. 4) and the radiographic appearance may then be difficult to distinguish from early stages of the

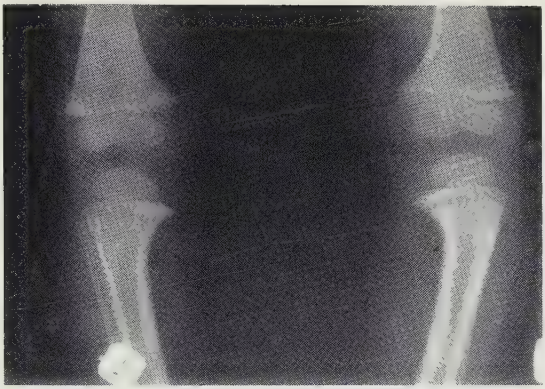


Fig. 4.

Healed rickets — case No. 66. The patient is 1 year 8 months old.

infantile type of Mb. Blount. A thorough analysis of the case history and appropriate radiographic and laboratory examinations usually establish the diagnosis.

Hypophosphatemic (Vitamin D- Refractory) Rickets

Albright et al (1937) showed that this disease differs from ordinary infantile rickets in its refractoriness to ordinary vitamin D therapy. The effective dose varies between 100,000 and 1,500,000 units a day. The response to treatment varies widely from one patient to another, and each case offers its own peculiar problems as the optimal range of dosage is very narrow. Overdosage causes toxic symptoms and underdosage will fail to produce the desired result.

Saville et al (1955) demonstrated that addition of large doses of sodium phosphate to the diet increases the calcium and phosphate retaining effect of vitamin D; this leads to healing and reverses the metabolic defects toward normal, even making it feasible to reduce the dose of vitamin D.

Stickler (1963) showed that after treatment with large doses of vitamin D the fecal excretion of calcium and phosphate decreases, probably because of increased absorption from the gastrointestinal tract.

The condition is twice as common in girls as in boys (Tachdjian 1972). There is a familial incidence (Christensen 1940, Pedersen et al 1951, and Tachdjian 1972). Blood analysis shows a reduced concentration of inorganic phosphate in the serum, normal or low serum calcium and increased alkaline phosphatase; other findings are decreased uninary calcium and increased faecal content of calcium and phosphate.

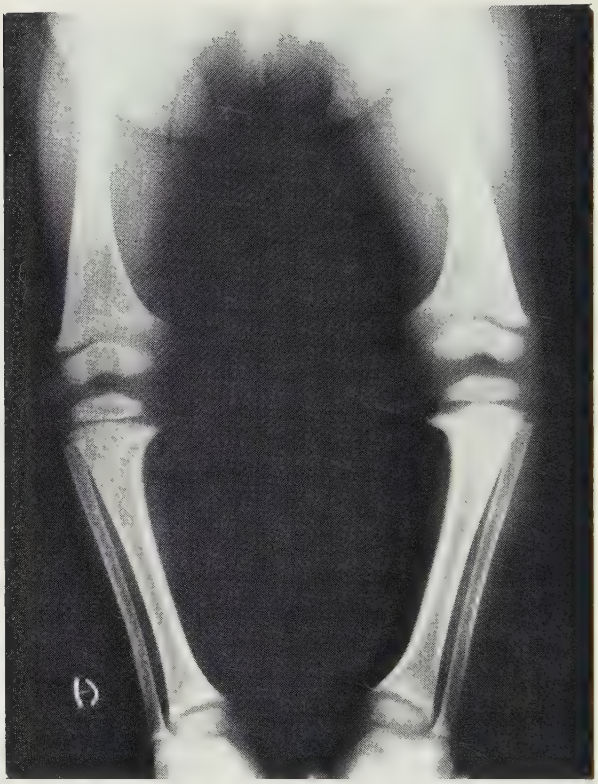


Fig. 5.

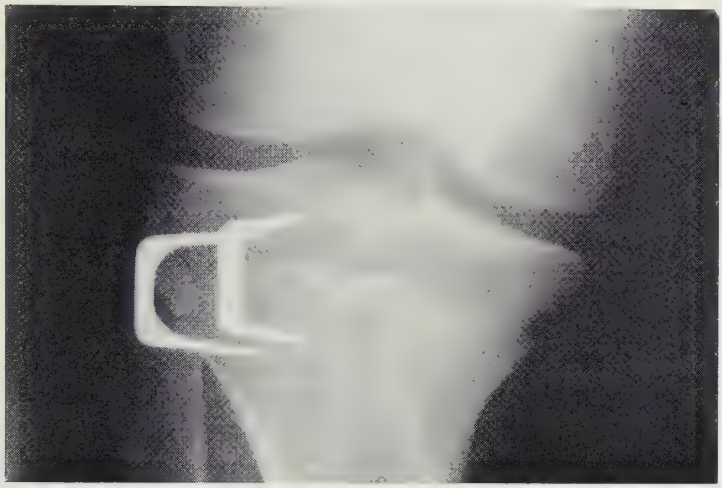
Hypophosphatemic (vitamin D — refractory) rickets — case No. 132. The patient is 2 years 7 months old.

The problem is that in early stages of vitamin-D-resistant rickets the appearance — radiographically — may be confused with the infantile type of Mb. Blount (Fig. 5), but one may see that both the femur and the tibia are deformed, the growth plates are irregular and the architecture of the bone is coarse and irregular. All the bones are somewhat rarefied.

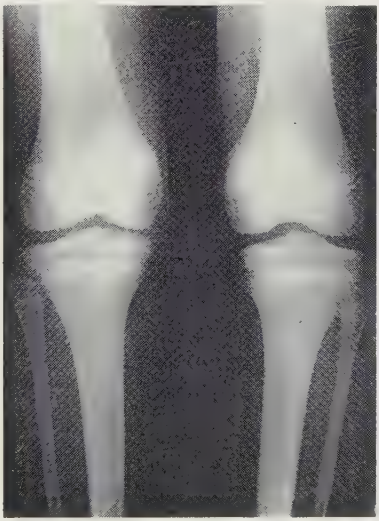
According to Pierce et al (1964), bracing is more appropriate therapy of the deformities until growth is complete. Surgical treatment should be avoided before puberty because of recurrence, but if coxa vara develops, corrective subtrochanteric osteotomy should be performed without delay. The operation technique consists of multiple osteotomies of the tibia, with intramedullary nail fixation, and weight bearing after post-operative immobilization in long plaster cast.

4—6 weeks prior to operation, administration of vitamin D but not phosphate must be discontinued because of the risk of serious toxicity (Pierre et al 1964, and Tachdjian 1972).

Fig. 6. Post traumatic genu varum.



a — 15 year old boy who had been operated for hairlip at 3 months of age, a graft was taken from the medial proximal part of the right tibia. Later at age 11, varus deformity could be seen. The X-ray appearance is wery similar to Mb. Blount-Juvenile type.



b — 14 year old boy who had been treated with radiotherapy at age of 5 years because of sclerodermia on inner side of the left knee. Later at age 14, varus deformity could be seen. The X-ray shows slight varus in the proximal tibia resembling the juvenile type of Mb. Blount.

Post- Traumatic Genu Varum

Localized lesions occur in the medial part of the physis of the proximal tibia in some cases after axial trauma, causing a local compression and damage to the physeal cartilage (Salter and Harris 1963, Hansson 1972).

Progressive genu varum and longitudinal growth arrest similar to Mb. Blount (Fig. 6) may also occur after operative trauma and after radiotherapy.

III. Material and Methods

1. Collection of Material

The material comprised 131 knees with Mb. Blount in 85 patients. One of the purposes of the investigation was to trace as many cases of Mb. Blount as possible in Sweden. The geographic distribution of the cases found is given in Table 2. The nature of the disease is such that most patients are usually seen on at least one occasion at a department of orthopaedics. The in-patient records of all departments of othopaedic surgery in Sweden were therefore searched. At the orthopaedic hospitals Vanföreanstalten in Stockholm, Härnösand and Helsingborg also the outpatient records were studied. In addition, records of the children's hospitals in Gothenburg and in Stockholm were studied. At these hospitals and at the departments of orthopaedics in Malmö and in Falun, the classification and registration systems were such that it was difficult to trace cases of genu varum; the files of the respective roentgen departments were searched instead. Since the names under which cases of Mb. Blount were entered in the hospital records varied widely from one department to another (Table 2) relevant cases were often difficult to find. Therefore all the records in which some form of genu varum had been noted or suspected were set aside for later. closer examination. Of the cases of genu varum thus collected from the hospital records, those in which genu varum had obviously been caused by conditions other than Mb. Blount, e. g. fracture, arthritis, arthrosis, physiologic or prenatal genu varum, rickets and tumor were excluded. After exclusion of these cases the material consisted of 180 cases of genu varum, possibly due to Mb. Blount (Fig. 7). This material was re-examined with analysis of available radiograms and data extracted from the charts. On the basis of this analysis 131 knees in 85 cases were identified in which the diagnosis of Mb. Blount satisfied the criteria specified above (page 13).

Since the diagnosis Mb. Blount rests on the radiographic examination, some cases were certainly missed, either because they had not been examined radiographically or because old films had been discarded. Moreover, the records of some patients were incomplete. For example, in some it was simply stated that the patient had severe genu varum or that

Table 2.

Sources of the material in Sweden

No.	CLINIC	Cases reported	Period covered by material	DIAGNOSIS
1	Apelviken Hospital - Varberg	4	1960—1970	Genu varum sin.; Genu varum (Mb. Blount) bil. precep sin.; Genu varum; Genu varum (Idiopathica dx.) +Genu varum (Mb. Blount - Metaphysstadiet) sin.
2	Boden	5	1950—1966	Genu vara sin.; Genu vara.; Tibia vara dx.; Tibia vara bilat.; Genu vara.
3	Borås - Solhem Hospital	3	1932—1970	Tibia vara+genu recurvatum bilat.; Genu varum dx.; Genus varus sin.
4	Eskilstuna	0	1965—1971	— — — — — — — — — — —
5	Falun - X-ray department	3	1948—1971	Brevitas crur dx (Blount's disease); Tibia vara amb. Rakit? Blount's disease?; Gen var. bil. (growth disturbance).
6	Gävle	0	1964—1971	— — — — — — — — — — —
7	Pediatric Hospital. Orthopedic depart. (Gothenburg)	1 5	1960—1970 1940—1970	Hypothyreos? Rachit?; Gen varus bilat.; Genua vara rechit.; Genua vara rachitica.; Ante crura vara.; Gen. vara amb. specially-dx.
8	Helsingborg - Vanföreanstalten	5	1913—1967	Morbus Blount.; Morbous Blount gen sin; Morbus Blount gen amb.; Gen vara rachit grav (1958), but Morbus Blount bilat (1960); Gen vara grav (Mb Blount).
9	Härnösand - Vanföreanstalten	8	1930—1971	Gen var bilat (Morbus Blount); Genu varum sin (endocrin?, dwarf?).; Genu varum rachit.; Genu varum sin; Gen vara rachitica.; Genu varum bilat.; Genus varus sin.; Antecrus varus dx (p. rachit).

Table 2 (continued)

No.	CLINIC	Cases reported	Period covered by material	DIAGNOSIS
10	Jönköping	5	1955—1965	Genua vara.; Antecrura vara amb.; Antecrura var dx-Blount's disease; Antecrura vara-crus varus dx.; Antecrura vara bilat.
11	Kalmar	1	1969—1971	Genu varum sin.
12	Karlskrona	0	1971—	— — — — — — — — — — —
13	Karlstad	1	1960—1971	Genua vara.
14	Kristianstad	1	1953—1971	Genu varus sin.
15	Lidköping	0	1964—1967	— — — — — — — — — — —
16	Linköping	0	1950—1966	— — — — — — — — — — —
17	Lund	7	1956—1971	Genu vara grav amb.; Mb. Blount?; Osteochondrosis deformans tibiae bilat.; Tibia var dx (Blount's disease); Gen var amb.; Mb. Blount.; Mb. Blount.
18	Malmö - X-ray department	3	1940—1967	Blount's disease.; Genu varum sin.; Mb. Blount.
19	Norrköping	1	1955—1971	Blount's syndrom.
	STOCKHOLM			
20	Vanföreanstalten - (Norrbacka)	6	1930—1969	Blount's osteochondrosis tibia bil.; Gen var.; Genu varus sin; Genua vara.; Genu varum.; Genu varum sin (Morbus Mau-Nilsonne); Genua vara.; Mb. Blount; Genu varum sinister.
21	Eugeniahemmet	0	1945—1971	
22	St. Göran Hospital	0	1910—1968	
23	Söder Hospital	0	1944—1968	
24	Danderyd Hospital - Karolinska X-ray	2	1965—1970	
	pediatrical depart.	1	1952—1971	
25	Uddevalla	0	1966—1970	— — — — — — — — — — —
26	Umeå	6	1959—1971	Gen. varum idiopaticum bilat.; Genu varum amb.; Crus varus dx.; Tibia vara sin.; Gen. varus dx. (1966) but Tibia vara idiopatica dx (Morbus Blount?) - (1969).; Genu varum sin.

Table 2 (continued)

No.	CLINIC	Cases reported	Period covered by material	DIAGNOSIS
27	Uppsala	7	1957—1971	Deformitas tibiae dx post traumatica (Morbus Mau-Nilsonne); Tibia vara dx; Antecrur. vara grav.; Antecrura vara grav.; Morbus Blount.; Genu varum dx; Genu varii bil.
28	Vejbystrand	0	1959—1971	— — — — — — — — — — —
29	Västerås	7	1955—1969	Crura vara gravis (Mb. Blount); Gen vara congen. bil.; Gen vara sin.; Gen vara.; Gen varum.; Gen var congen dx.; Genua vara rachitica.
30	Växjö	0	1969—1971	— — — — — — — — — — —
31	Örebro	2	1947—1966	Exostosis tibiae sin+genu vara sin.; Laesio epiphyseo-tibia sin.
32	Östersund	1	1960—1971	Genu varum amb.
	TOTAL	85 cases		

the child was difficult to examine because it kicked and cried! The *incidence* of Mb. Blount was calculated according to Table 3. It was found, that at least 5 newborns per year in Sweden will have Mb. Blount. In 66 of the 85 probands studied, the last examination was performed by the author.

2. Case History

The anamnestic data were obtained from the parents and/or from the patients and from the patient's case sheet. In each case the age at onset, presenting symptoms, and treatment were analyzed.

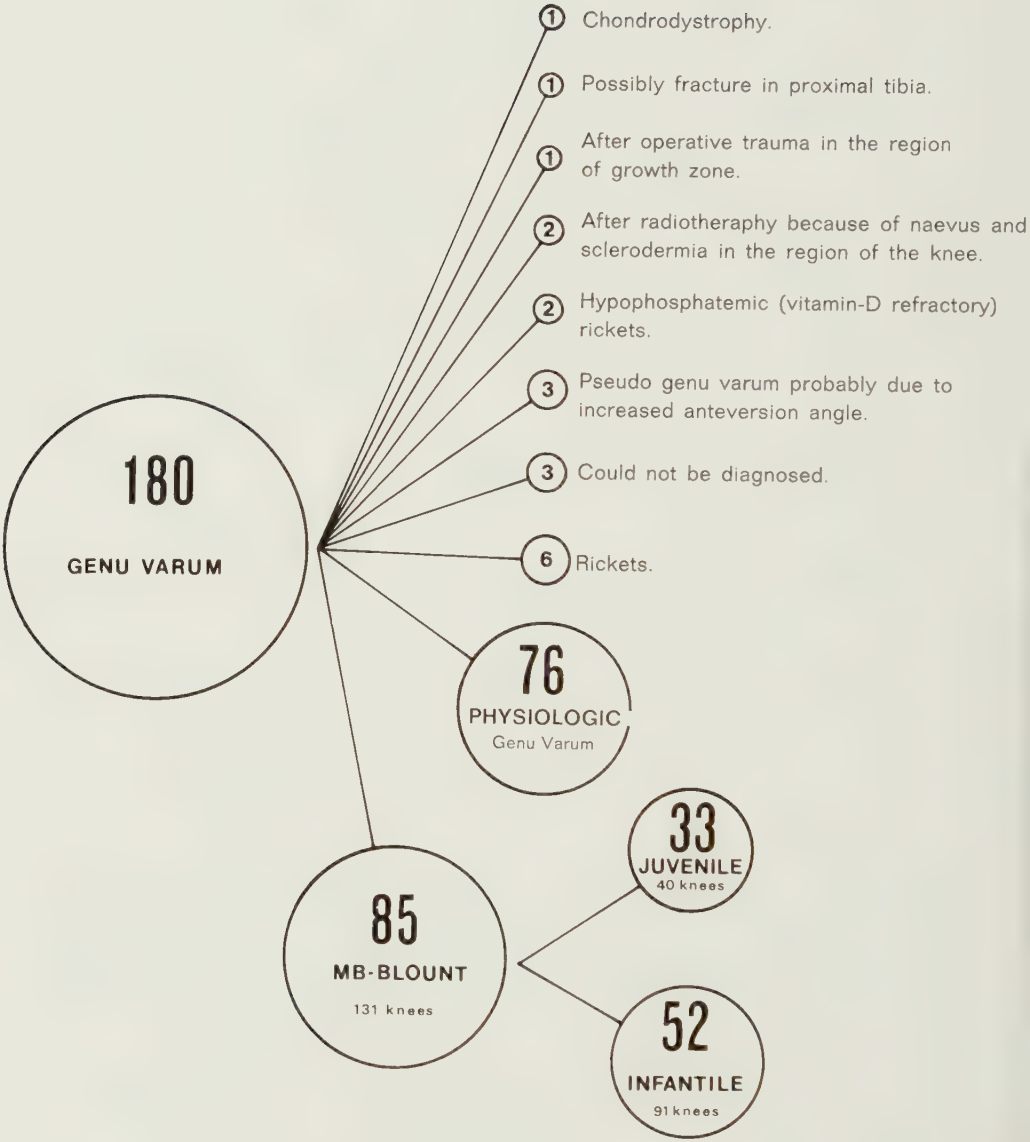


Fig. 7. Distribution of 180 cases of genu varum.

Table 3. Incidence of Mb. Blount in Sweden.

Years	A No. of children born in Sweden	B No. of cases born at the same years	I/J	Mb. Blount per million newborn
1905	—	1	0/1	—
1920—1924	605.912	2	1/1	3
1925—1929	497.022	4	2/2	8
1930—1934	445.185	2	1/1	4
1935—1939	446.543	1	1/0	2
1940—1944	569.849	7	3/4	13
1945—1949	644.704	19	8/11	30
1950—1954	551.014	17	6/11	31
1955—1959	532.678	10	8/2	19
1960—1964	549.571	14	14/0	25
1965—1969	588.229	8	8/0	14

To compare different periods, the frequency of Mb. Blount was expressed as the number of cases per 1 million newborns. The increased frequency since the end of the 40s may be due to the wider use of radiography, storage of the films and possibly to the patients seeking medical advice earlier and more frequently.

To calculate the ratio between the infantile (I) and the juvenile (J) types, the period after 1960 must be excluded because the juvenile type has not been yet reported since it appears at 7—14 years of age.

For the other periods the average ratio was 1/1. Applying this ratio for the period 1960—1964, the frequency of Mb. Blount will be 50 per 1 million newborns. With an average of about 500,000 newborns per 5 years, this means that the incidence of Mb. Blount in Sweden is 5 new cases per year.

3. Clinical Examination

The spine, upper extremities and hip joints were examined routinely. The knee joints were examined for varus, valgus (Fig. 8), and recurvatum deformities (Fig. 9), both in lying and standing positions, range of motion and instability both in the frontal plane, i.e. medial or lateral, and in the sagittal plane, i.e. backward-forward mobility of the tibia. In addition the lower extremities were examined for internal rotation of the tibia (Fig. 10), distance between the knees when standing with the feet together, muscle atrophy of the thigh or calf, unilateral shortening of the leg, limping or waddling, and faulty loading of the feet.

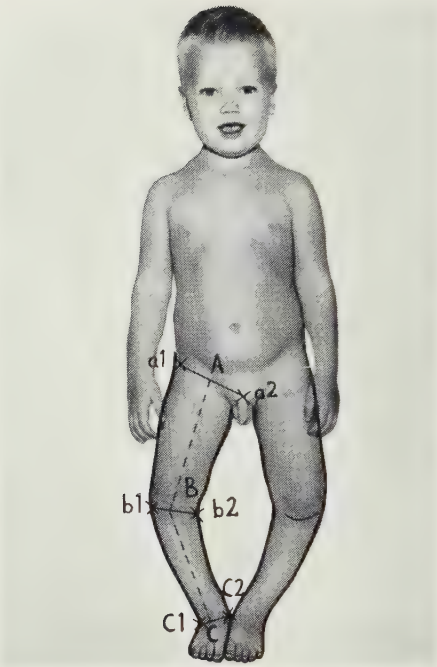


Fig. 8 (Case No. 45).

Clinical measurement of the angle of varus deformity.

a1 : superior anterior iliac spine.
a2 : pubic symphysis.
A : midinguinal point.
b1 : lateral joint space at the most prominent part of the lateral femoral condyle.
b2 : medial joint space at the most prominent part of the medial femoral condyle.
B : mid-knee point (i.e. midway between b1 and b2).
c1 : lateral malleolus.
c2 : medial malleolus.
C : mid-trans-malleolar point.
The clinical varus angle is formed by the two lines AB and BC.

4. Radiographic Examination

At follow-up all knees except 5 were examined radiographically. The examination was done according to the method described by Clark (1964) and is briefly outlined below. All projections were made with the patient lying down. Antero-posterior projections were obtained with the patient supine and the knees relaxed. When necessary, the leg was rotated slightly outward so that the patella pointed upward.

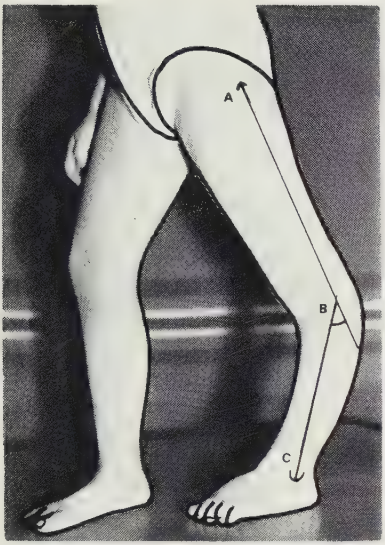


Fig. 9 (Case No. 120).

Clinical measurement of the angle of recurvation.

AB: The longitudinal axis of the thigh, drawn between the trochanter major and lateral joint space at the region of the most prominent point of the lateral femur condyle.
BC: The longitudinal axis of the leg drawn between the lateral joint space and the lateral malleolus.
The angle formed by these two lines is the recurvatum angle. An error may be introduced by pronounced rotation of the leg. In these cases, the longitudinal mid-line can be used when the patient is in standing position with both feet together.

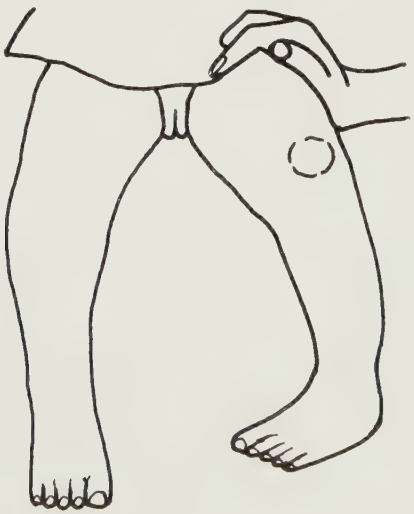


Fig. 10.

After Turek (1967). Clinical measurement of the angle of torsion.
The knees are flexed, and the ankle is held at a right angle. The relation of the foot to the sagittal plane measures the angle of torsion.

Medio-lateral projections were obtained with the limb flexed at the hip and knee joints and with the transverse axis of the patella at right angle to the film. In small children, views were also obtained of the entire lower leg including the knee joint. During the analysis of the films attention was paid to:

a — The different stages of the disease, according to the author's classification (page 37).

b — The following Radiographic angles (Fig. 11):

1) FEMUR-TIBIA = angle 1

2) TIBIA-epiphysis-diaphysis = angle 2

3) TIBIA-plateau-diaphysis = angle 3

4) FEMUR-plateau-diaphysis = angle 4

5) FEMUR-epiphysis-TIBIA-diaphysis = angle 5.

Fig. 11.

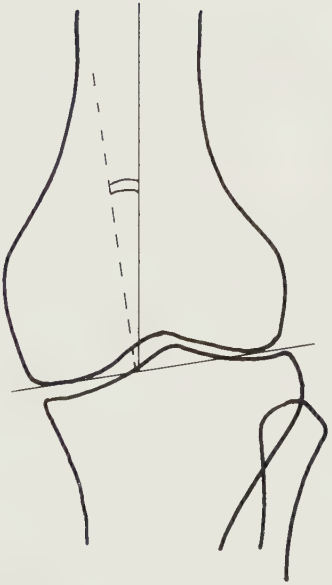
RADIOGRAPHIC ANGLES

Base of the knee: — line touching both condyles of femur-distally.

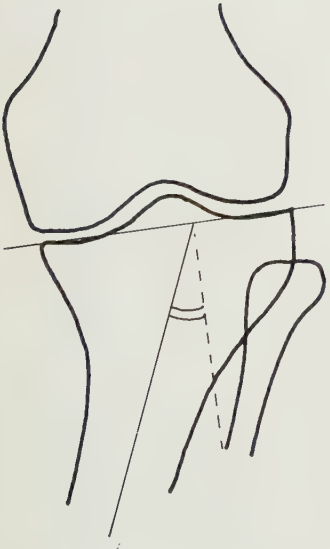
Long axis: — line parallel to diaphyses either of femur or tibia.

Angle 1.

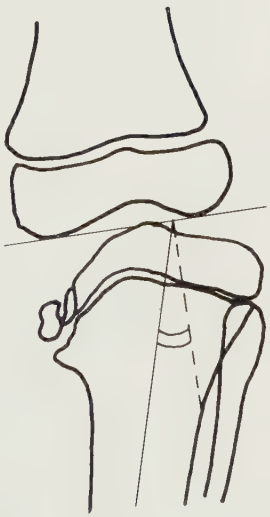
Angle 2.



Angle 4.



Angle 3.



Angle 5.

IV. Findings

1. Clinical Findings

a. *Distribution according to:*

Type: 52 patients (91 knees) were of the infantile type and 33 (40 knees) of the juvenile type. Nine patients (14 knees) were adult (see page 13). Of these 2 (4 knees) were infantile and 7 (10 knees) were juvenile.

Comparing with the material of Blount (1937) and Langenskiöld et al (1964) together, the figures are 70 cases infantile and 14 juvenile.

Sex distribution: 35 of the patients were male (55 knees), and 50 females (76 knees). Of the 52 infantile cases, 19 were male and 33 were female; of the 33 juvenile cases, 16 were male and 17 female. The sex distribution in the world's literature of sufficiently documented cases is 88 cases male to 193 cases female. The documented cases of Blount (1937) and Langenskiöld (1952) together are: 10 cases male and 26 cases female.

Side: Of the 52 infantile cases, 7 were right-sided, 6 left and 39 bilateral. In 11 patients of the infantile, the patients had physiologic genu varum on one side, and Mb Blount on the other (6 left and 5 right). Of the 33 juvenile patients, 10 were right-sided, 16 left and 7 bilateral. The world's figures are 64 cases right-sided, 32 left-sided, and 186 bilateral cases. It is impossible to specify the figures relating to the infantile and juvenile types.

Age at onset: The patients' ages at the time of onset of the disease, at the first examination and at the last examination (author's examination) are given in Appendix (page 106). The deformity in the infantile type was discovered at an age of, on the average, 1 year, but the patient were not examined before an average age of 3 years and 9 months. The last examination was made at, on the average, 13 years. The corresponding figures for the juvenile type were 11 years, 13 years, and 20 years. The adult patients were seen by the author after age 20.

b. *Symptoms and signs:*

The main reason why the patients or their parents sought medical help, was increasing varus deformity, while other complaints, e.g. pain or tiredness on exertion, were only occasionally present. Only in 31 cases (15 infantile, 16 juvenile), could such signs be reported during the development of the

disease (see Appendix). The general health of the children was excellent, and almost all of them periodically received the ordinary prophylactic dose of vitamin D. No signs of rickets, tuberculosis or any generalized bone disease were found.

Analysis of the material (see Appendix) revealed different degrees of the deformity at the last examination, but normal hip and spine, with normal range of extension-flexion movement of the knee joint.

In 20 infantile and 5 juvenile knees, 10—40° recurvation was observed.

In 17 infantile and 8 juvenile knees, 10—30° internal rotation of the tibia was observed.

Laxity of the knee, i.e. abnormal mobility of the knee on medial strain, was found in 11 infantile and 5 juvenile knees.

In 6 infantile and 12 juvenile legs there was 1—4 cm quadriceps atrophy, while in 4 infantile and 6 juvenile legs, 1—4 cm calf atrophy could be seen; one juvenile knee had 10 cm atrophy of the calf.

6 infantile and 7 juvenile patients limped, while one infantile and 2 juvenile patients waddled.

In 15 infantile and 21 juvenile legs there was shortening of 1—5 cm, and 22 infantile and 11 juvenile patients had flat feet.

2. Radiographic Findings

During the analysis of the material's radiograms, attention was paid to a — The Stages of Mb. Blount, and b — The Radiographic angles.

a — *The Stages of Mb. Blount*

The Infantile Type:

Langenskiöld's classification (1952) (see page 3) was tried at the beginning of the analysis of this material, but after repeated consideration and analysis, it was found that the infantile type has four rather than six radiographic stages (Scheller and Zayer 1970).

Langenskiöld's stages I, II and III describe only changes in the metaphysis. These stages are described here as a single stage of development of the condition, *the metaphyseal stage* because many more types of metaphyseal changes were observed here than the three described by Langenskiöld (see Fig. 12 and 13); I doubt whether any two cases exist with exactly the same appearance.

Langenskiöld's stage IV describes changes in the epiphysis, but his stage V in reality belongs to stage IV because both describe two variants of a single entity. Moreover, Langenskiöld (1952) mentioned that in stage V a triangular

Fig. 12. Metaphyseal stage — antero-posterior projections. Examples of different appearances and varus deformities.

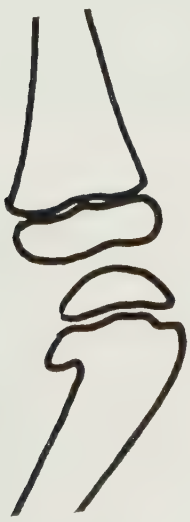
Case 9
(2 years)

Case 29
(2 years 1 month)

Case 25
(2 years 5 months)

Fig. 12 (continued)

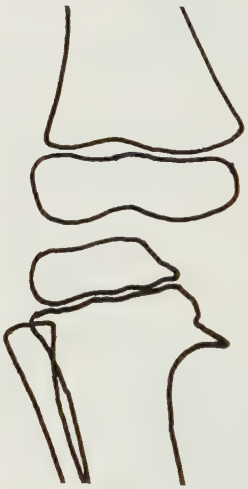
Case 39 (2 years 6 months)



Case 60 (2 years 10 months)

Fig. 12 (continued)

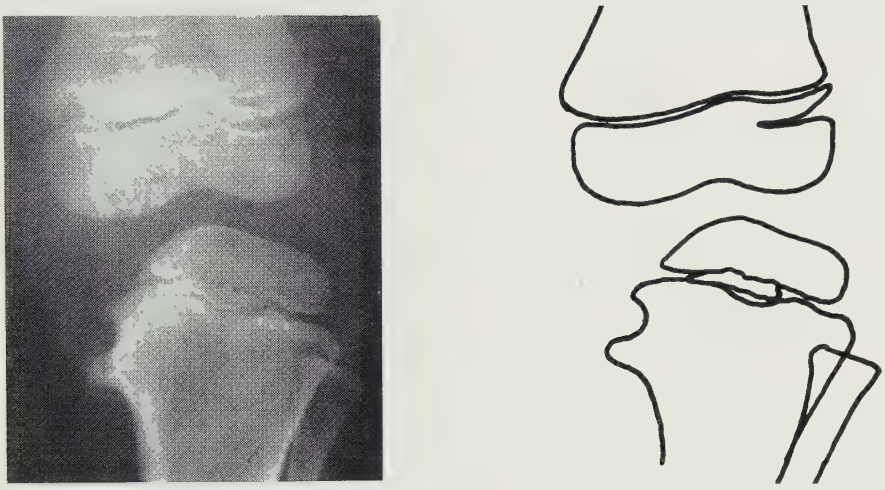
Case 8
(2 years 11 months)



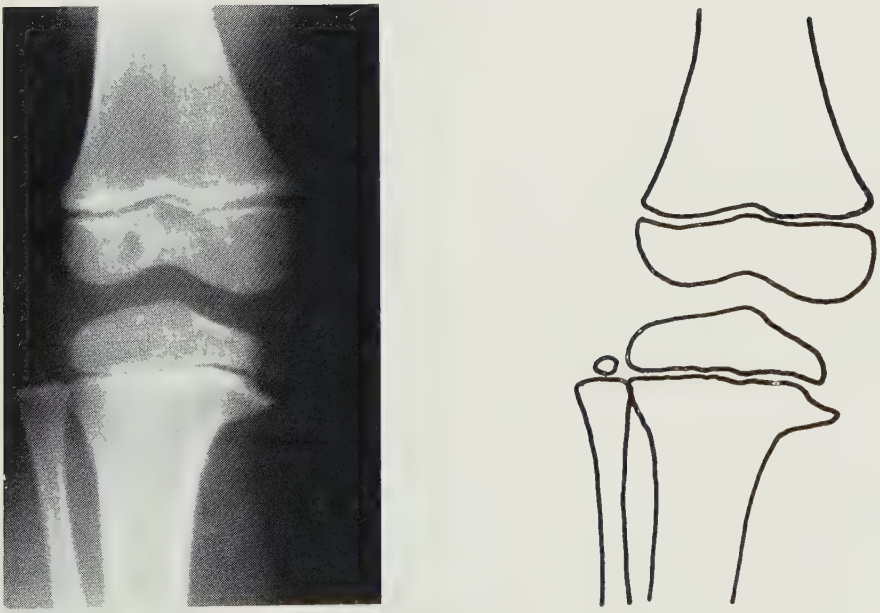
Case 74
(3 years 2 months)

Case 12
(3 years 3 months)

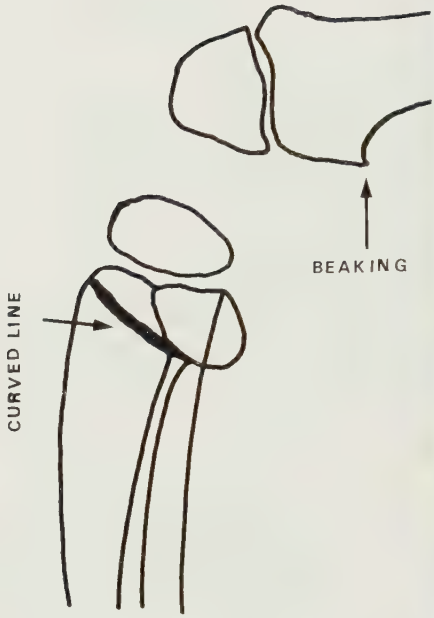
Fig. 12 (continued)



Case 162 (4 years 4 months)



Case 2 (4 years 9 months)



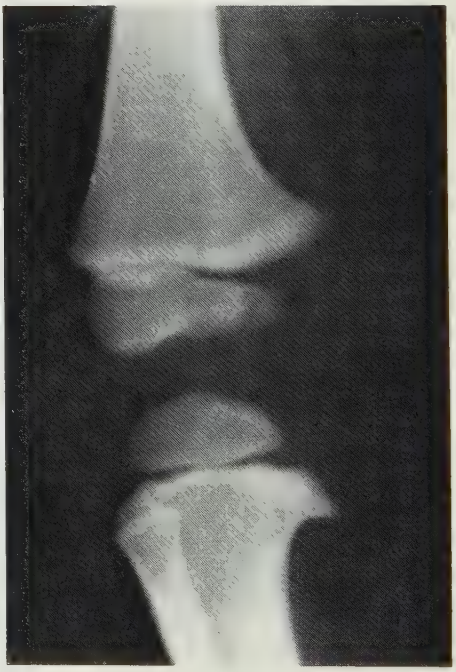


Fig. 13.

Metaphyseal stage — lateral projection. Case 126, 1 year 10 months old. The further growth of the "beak" from the medial part of the proximal tibial metaphysis is now distinctly seen in the lateral projection as a curved line.

fragment can be seen, but this phenomenon was not mentioned in his 1964 article and was described as an effect of double projection in 1970. Even in this *epiphyseal stage,* as in the metaphyseal, there are many different appearances (Figs 14 and 15).

Langenskiöld (1952) did not show in his sketch the appearance of changes preceding the metaphyseal changes. In the present material analysis of metaphyseal changes in 66 knees showed changes which were exactly the same as in severe physiologic bow leg in 8 knees at age 1—2 years. In 43 knees at age 1½—4 years a typical metaphyseal stage could be identified with a sequel of early initial changes in the form of persistant thickening of the dorso-medial part of the cortex of the tibia and persistant beaking of the medio-distal metaphysis of the femur. Only in 15 knees at age 4—10 years could no such initial changes be detected.

According to these observations the analysis of the radiograms in 91 knees in 52 patients was based on 4 different stages of development in the infantile type of Mb. Blount, the initial, metaphyseal, epiphyseal and adult stages.

1. *The initial stage* starts at age 1—2 years. This stage has exactly the same appearance as physiologic genu varum with "stress phenomenon" (see page 8), but because the subsequent development is entirely different, the designation "initial" has been used. It is impossible radiographically to distinguish between physiologic genu varum and the initial stage of Mb. Blount. This can only be done by continued radiographic control (see Case report 2). 8 knees in the material showed this initial stage.

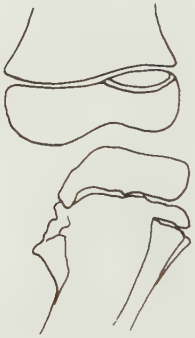
2. *The metaphyseal stage* (Fig. 12 and 13) started as early as at age 1—2 years. On further growth of the medial part of the proximal tibial metaphysis in medial and distal direction, the beak-like deformity increases (Fig. 12), and is now distinctly seen also in lateral projections, where it appears as a curved line (Fig. 13).

In this stage, irregularity of the metaphyseal part of the growth plate begins to appear and sometimes continues in the form of irregular rarefactions medially in the metaphyseal spongiosa and sometimes in the form of defects in that surface of the metaphysis facing the physis (growth plate) which thereby becomes more or less irregular.

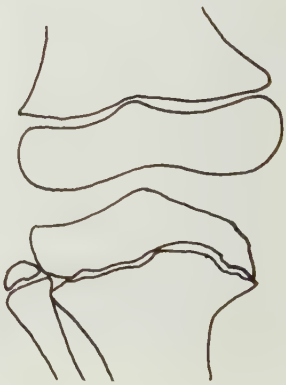
However, during the metaphyseal stage of Mb. Blount, the growth of the medial condyle becomes retarded so that in this stage radiography shows an incipient underdevelopment of the medial half of the bone nucleus of the proximal tibial epiphysis. Radiographically demonstrable changes in the metaphyseal stage are thus not localized only to the metaphysis, but since these changes dominate the picture so strikingly, it still seems valid to use the expression "the metaphyseal stage".

Fig. 14. Epiphyseal stage — antero-posterior projections. Examples of different appearances and varus deformities.

Case 123
(5 years 3 months)



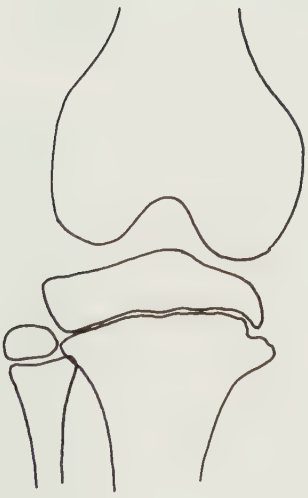
Case 56
(5 years 3 months)



Case 160
(6 years 9 months)

Fig. 14 (continued)

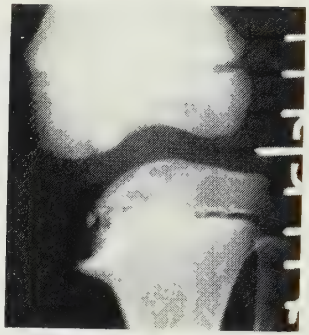
Case 164 (7 years)

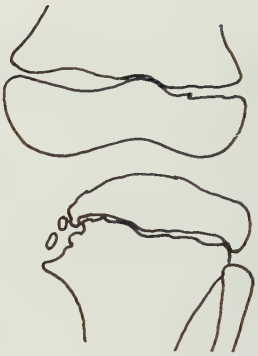


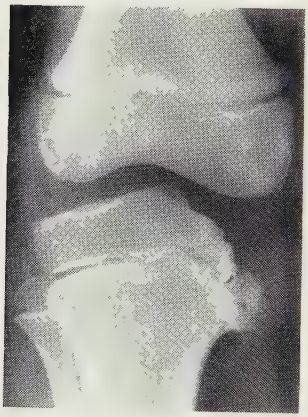
Case 111 (7 years 11 months)

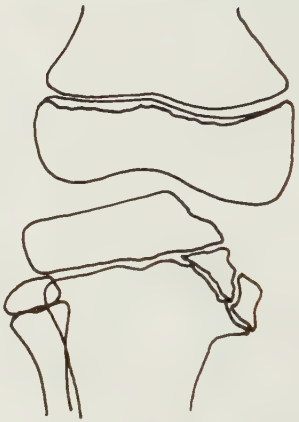
Fig. 14 (continued)

Case 137
(7 years 11 months)

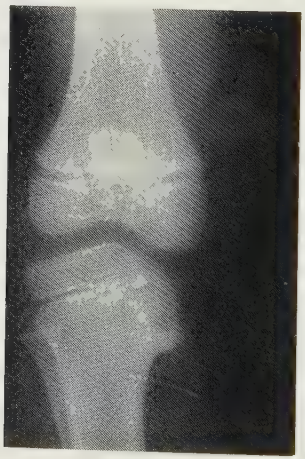


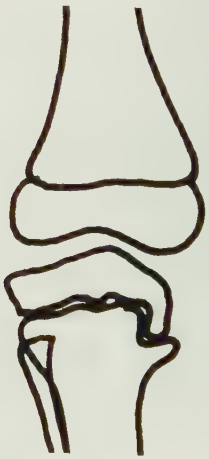






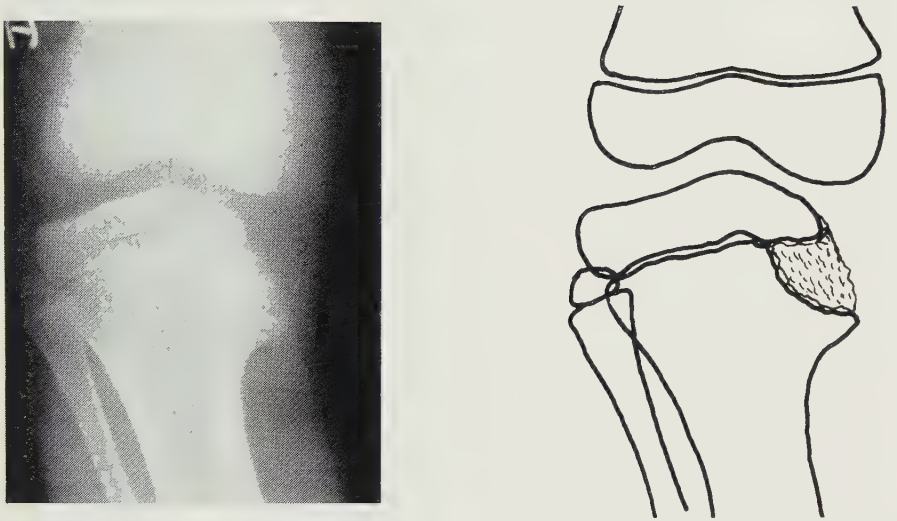
Case 12
(8 years 1 month)



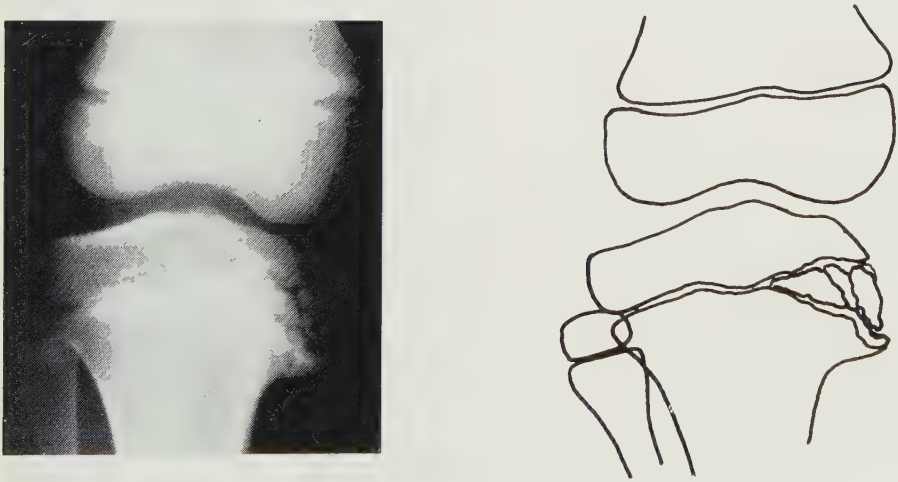


Case 11
(8 years 6 months)

Fig. 14 (continued)



Case 1 (9 years 6 months)



Case 149 (9 years 7 months)

Fig. 15.

Epiphyseal stage — lateral projection. Case 164, 7 years old. The overlapping of the metaphyseal and epiphyseal changes can be seen as a curved line.

3. *The epiphyseal stage* (Fig. 14 and 15) started after 5 years of age. During this stage the metaphyseal deformity progresses, partly because of a deepening of the groove in the proximal surface of the metaphysis and partly because of continued irregular growth medially. However, it is the epiphyseal deformity which dominates the radiograms during this stage because the underdeveloped medial part of the epiphysis grows down into the defect in the metaphysis and thus causes a deformity of varying appearance and severity (Fig. 14). In the lateral projections, also, a curved line can be seen which is due to overlapping of the metaphyseal and epiphyseal changes (Fig. 15).

4. *The adult stage* (Fig. 16 and 17) started at about 16 years of age. This is not a developmental stage of the infantile type, but the final stage, which persists after the physis (growth plate) in the proximal tibial end has closed. The deformity depends on how far the deformity had advanced before closure of the epiphyseal plate. In the adult stage it is impossible to tell whether the case is of the infantile or juvenile type (Fig. 16). This stage shows an angular line in the lateral radiographic projection (Fig. 17).

The natural history of the infantile type is reflected in the above 4 stages, but the development and prognosis of all 4 stages cannot be identified in each case, because the patients do not seek medical help at exactly the same age. The distribution of the material in different ages is shown in Fig. 18.

The Juvenile Type

The clinical varus deformity in the Juvenile Type started as early as at 6 years of age, and at the latest at 14 years, but the patients were not examined radiographically before the age of 7 years, and at the latest at age 15 years, and therefore it is difficult to accept these figures as definitive. Also, the radiographic examinations were performed at irregular intervals, and the changes observed here may very well have existed long before these examinations.

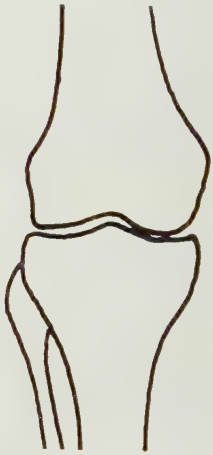
The varus deformity in the juvenile type rarely reaches the severity of the infantile type. Radiographically the deformity varies in appearance and severity (Fig. 19). In general, the spongiosa in the medial part of the proximal tibial metaphysis and adjacent part of the epiphysis is irregular, and the medial part of the metaphysis is plump and somewhat depressed. The medial tibial condyle is depressed to a corresponding degree and somewhat lower than the lateral tibial condyle, but rarely deformed to any substantial extent. In the lateral projection, the posterior spur on the proximal tibia is more prominent than the curved line (Fig. 20).

Fig. 16. Adult stage: also shows different appearances and varus deformities, but it is impossible to tell whether the case was infantile or juvenile type.

The infantile type:

Case 71
(44 years 10 months)
varus.

Case 74
(20 years 2 months)
no varus.

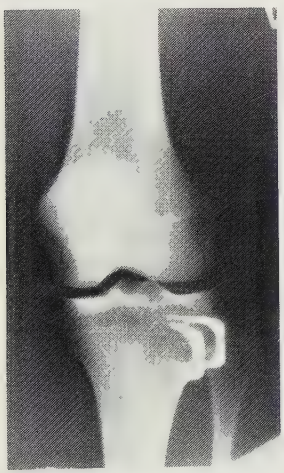


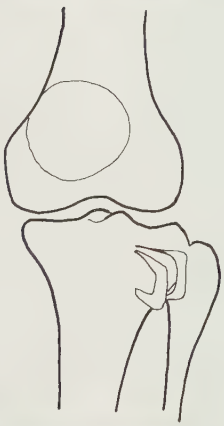
Case 1
(31 years)
bayonet knee.

Fig. 16 (continued)

The juvenile type:

Case 14
(17 years 1 month)
varus.





Case 177
(19 years 9 months)
no varus.

Case 34
(26 years 3 months)
bayonet knee.

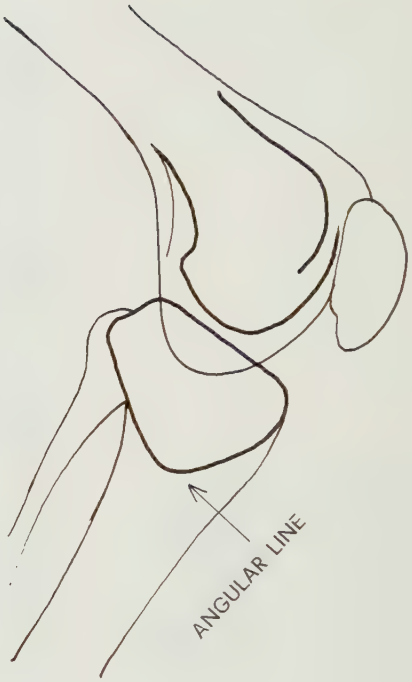


Fig. 17. Adult stage — lateral projection. Case 3 (58 years 6 months). The medial condyle is lower than the lateral, which can be seen as an angular line.

At the adult stage it is impossible by radiography to distinguish the juvenile type from the infantile type (Fig. 16). In 10 juvenile knees (Fig. 21) the growth plate closed prematurely.

Arthrography: Arthrography was performed in 5 knees. The ages of the patients were 2½ years in a bilateral case, 8 years in one, and 20 years in two cases. In all 5 knees, arthrography was normal except the 8 years old which showed the same findings as observed by Langenskiöld and Riska (1964); (see page 11).

b — *The Radiographic angles*

Five angles were studied (Fig. 11). The radiographic angles were measured on two occasions, first when the diagnosis of the type of the stages was certain and again at the last examination. The radiographic angle and the clinical angle were studied for any correlation, as were these angles and the severity of the changes in the medio-proximal part of the tibia. It was found that, generally speaking, the clinical angle noted in the patient's records differed from the angle found in the radiograms. This was partly because of lack of precision of measurement of the clinical angles and partly because the films which consisted of standard a—p and lateral projections obtained at different roentgen departments differ from one another regarding quality and the exact projection.

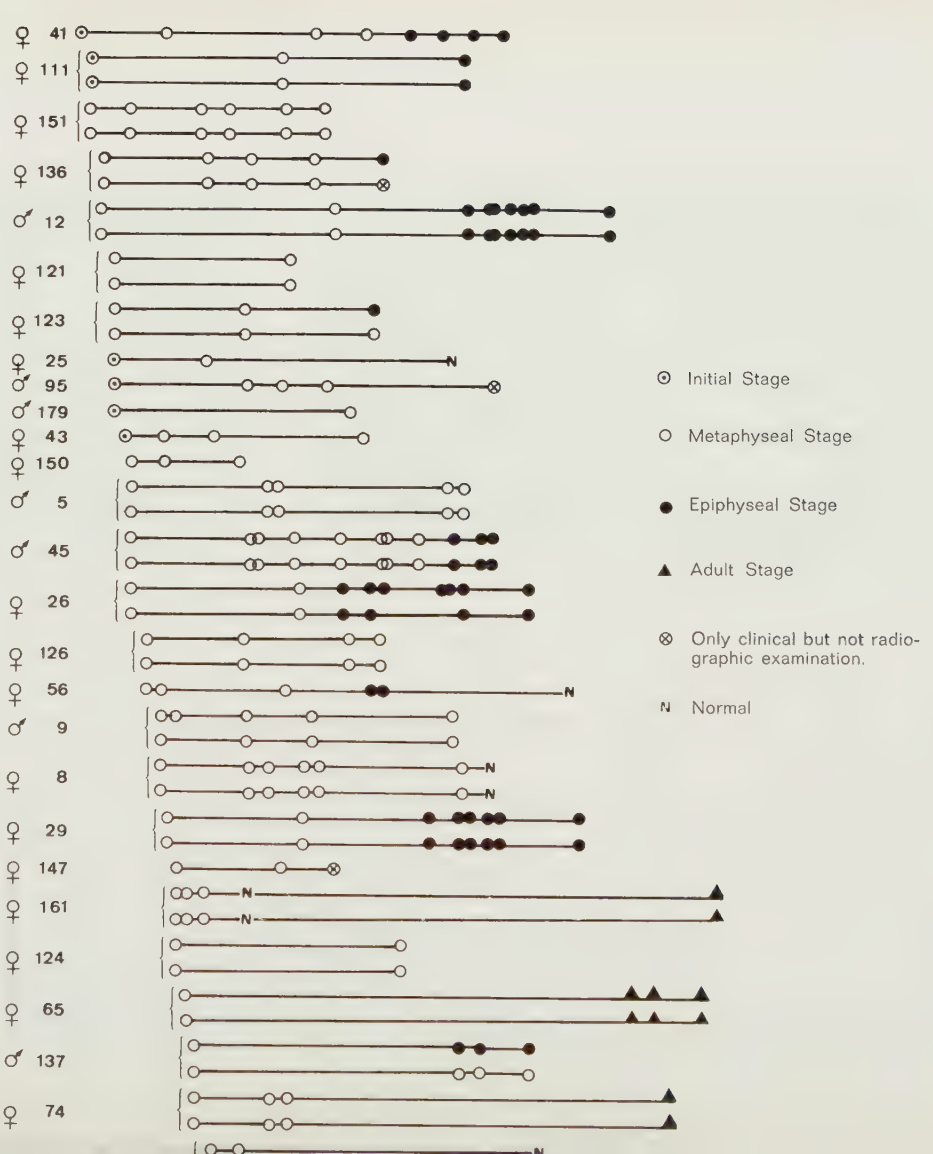
It was noticed (Fig. 22) that the severity of the changes in the medio-proximal part of the tibia was not always accompanied by increased varus deformity of the proximal tibia.

At the last roentgen examinations, standard projections (Clark 1964) were used throughout. The radiograms obtained at these examinations were so similar in projection that they could be used to study the radiographic and clinical angles for any correlation.

The varus deformity in Mb Blount is confined to the proximal part of the tibia (page 9) and there is an abnormal angle between the base of the knee, i.e. the line passing the most distal part of the femoral condyles, and the diaphysis of the tibia.

1) *The* FEMUR-TIBIA = *angle 1* measures also deformities of the femur. This angle is exaggerated in cases of physiologic genu varum without any changes of Mb. Blount. Moreover, this angle may be 0° in Mb. Blount with bayonet leg, i.e. varus position of the proximal tibia compensated by valgus position in the distal femur (Fig. 16).

2) TIBIA-*epiphys-diaphysis* = *angle 2* can be used in the metaphyseal stage. In the epiphyseal stage, on the other hand, it is often not possible to draw a straight line along the epiphyseal line because of the defect of the medio-proximal tibia and because the epiphyseal line is not alway straight.


♀ 41
♀ 111
♀ 151
♀ 136
♂ 12
♀ 121
♀ 123
♀ 25
♂ 95
♂ 179
♀ 43
♀ 150
♂ 5
♂ 45
♀ 26
♀ 126
♀ 56
♂ 9
♀ 8
♀ 29
♀ 147
♀ 161
♀ 124
♀ 65
♂ 137
♀ 74
N
Initial Stage
Metaphyseal Stage
Epiphyseal Stage
Adult Stage
Only clinical but not radiographic examination.
N Normal

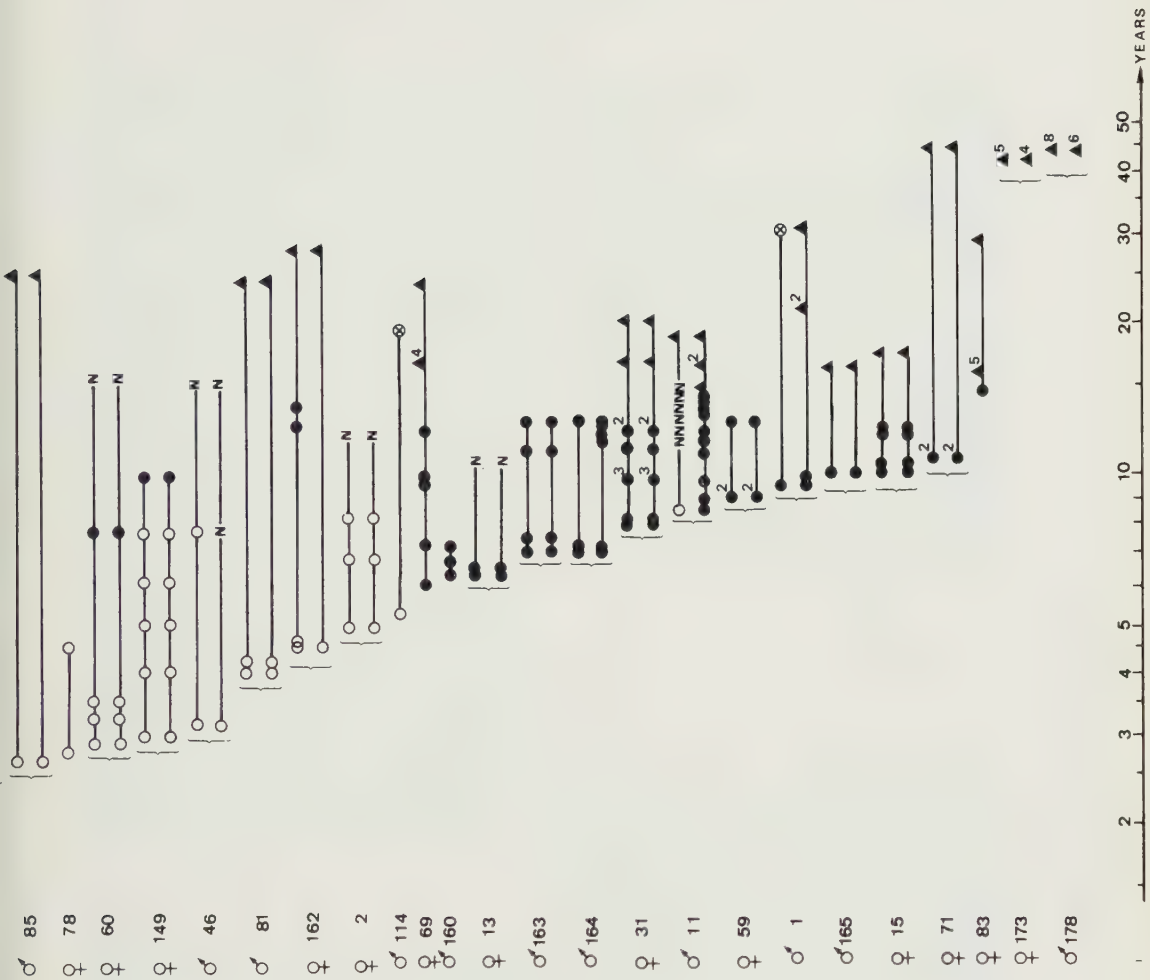
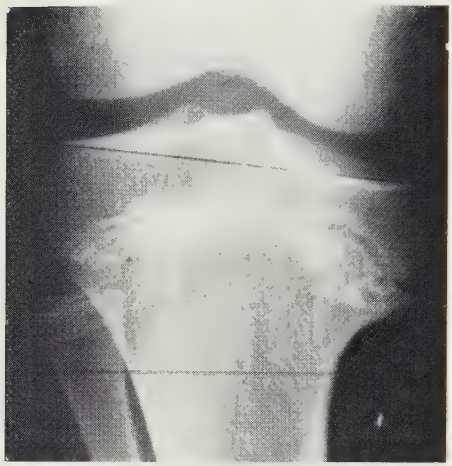
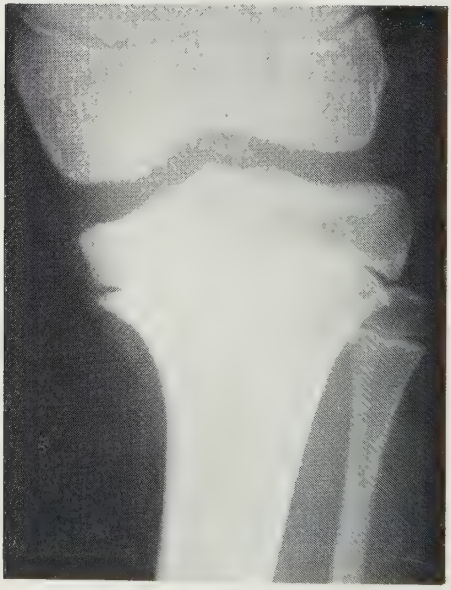


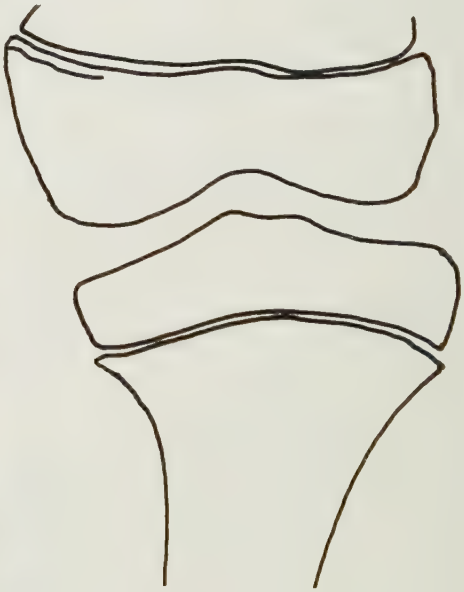
Fig. 18. The distribution of radiographic examinations of 91 knees with Mb. Blount of the infantile type. The figure shows that the initial stage started at 1—2 years, the metaphyseal as early as at 1—2 years of age, the epiphyseal after 5 years, and the adult stage started at about 16 years of age.

Fig. 19. Juvenile type — antero-posterior projections. Examples of different appearances and varus deformities.



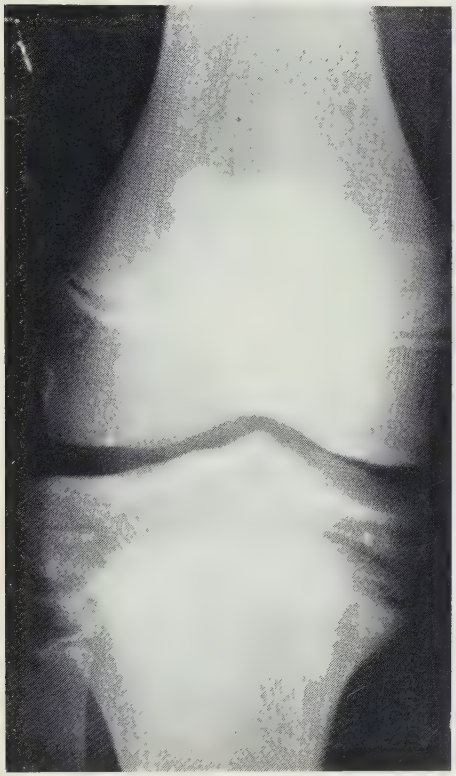
Case 100 (10 years 6 months)

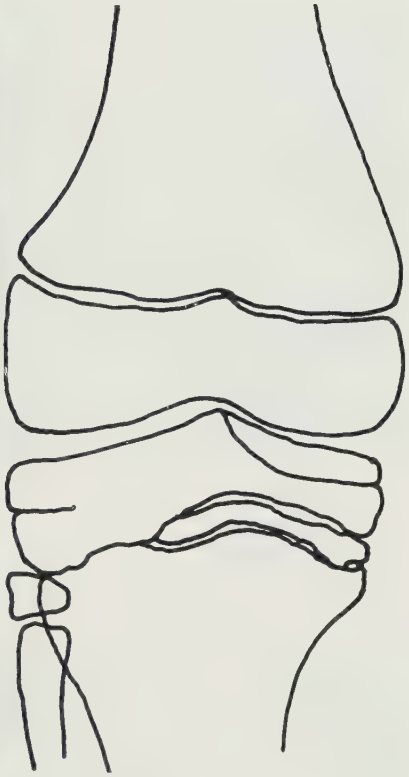




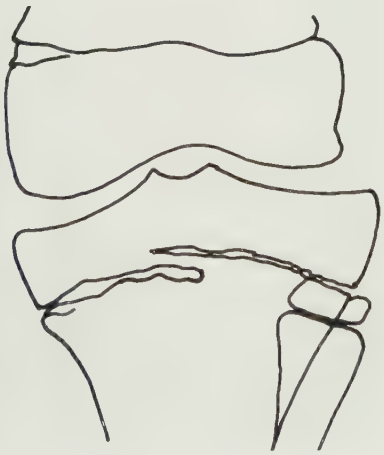
Case 104 (10 years 11 months)

Fig. 19 (continued)



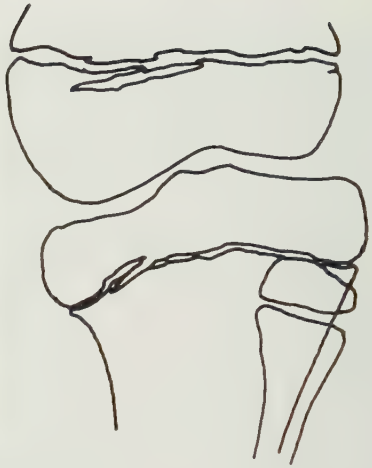


Case 4 (12 years 2 months)

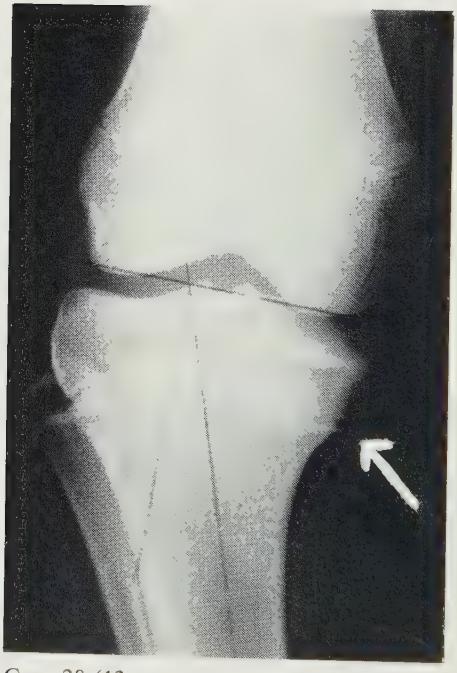


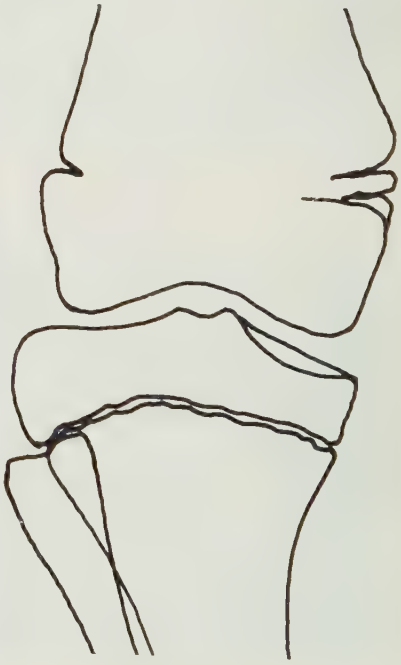
Case 54 (12 years 3 months)

Fig. 19 (continued)



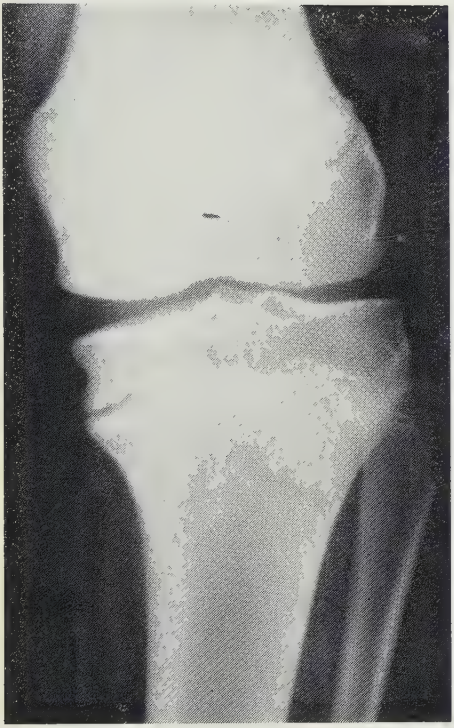
Case 156 (12 years 8 months)





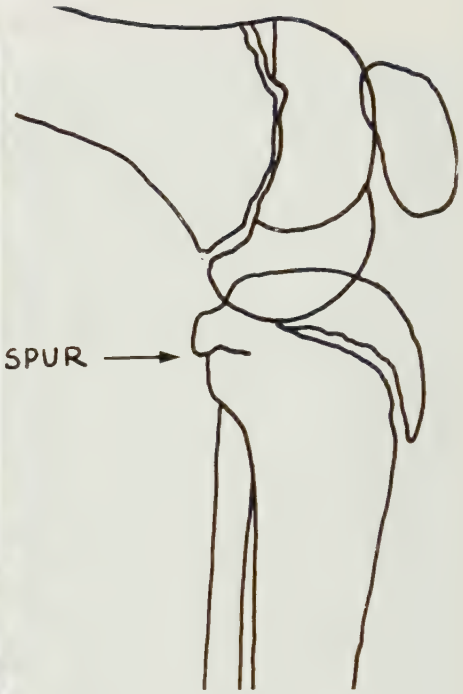
Case 28 (12 years 10 months)

Fig. 19 (continued)



Case 57 (14 years)

Case 86 (15 years 6 months)



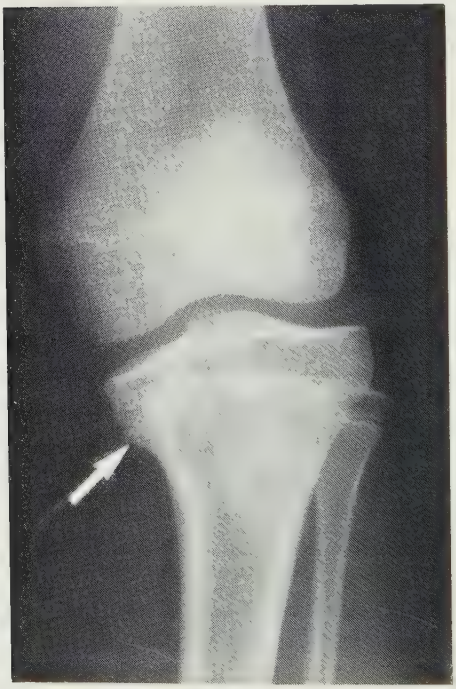


Fig. 20. Juvenile type — lateral projection. The posterior spur on the proximal tibia is more prominent than the curved line.
Case 16 (10 years 5 months)

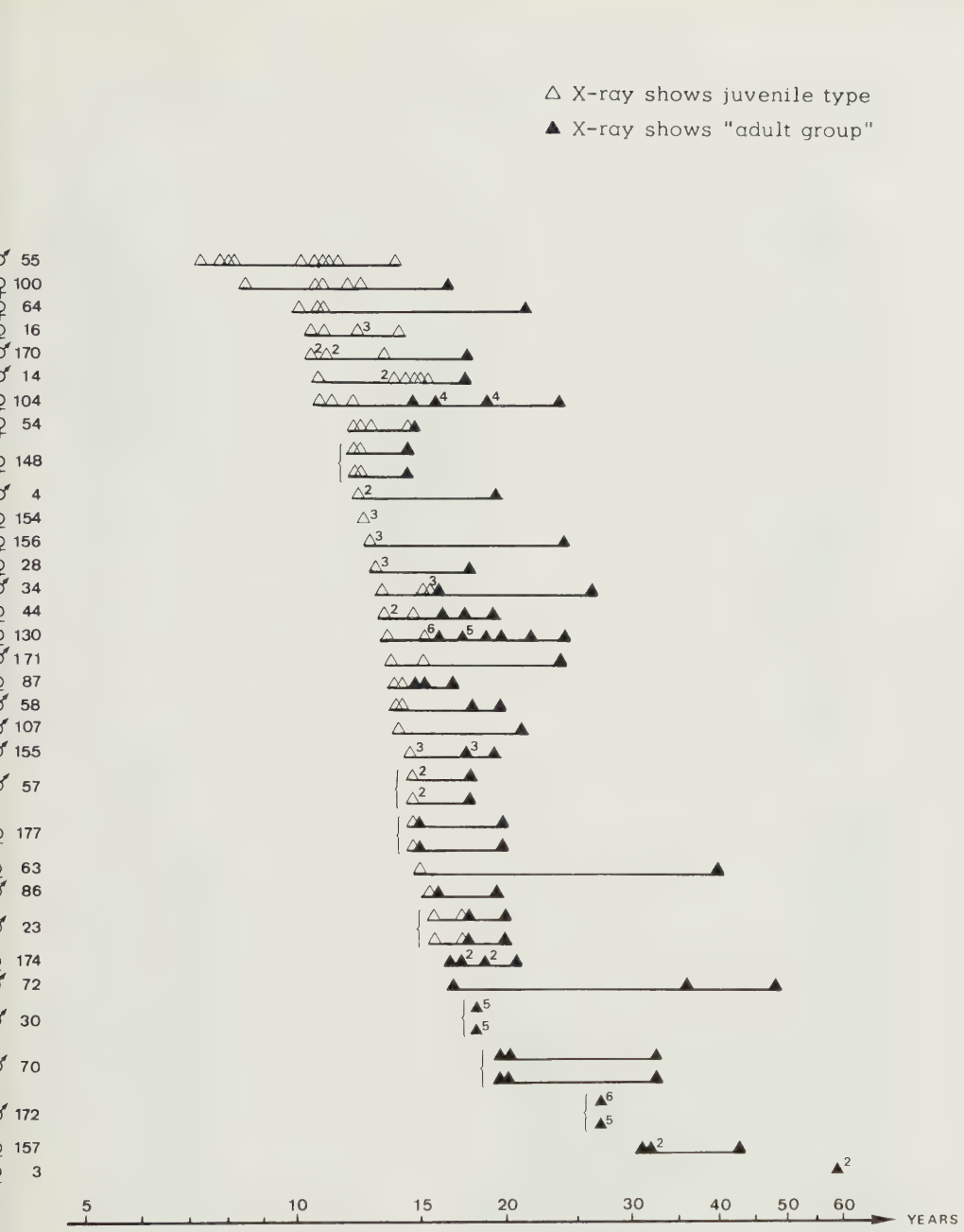
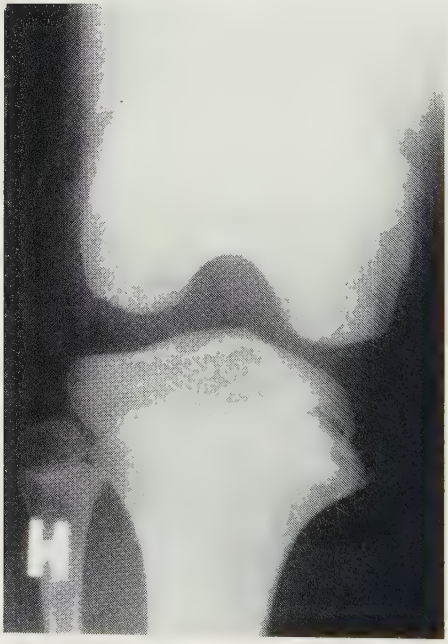
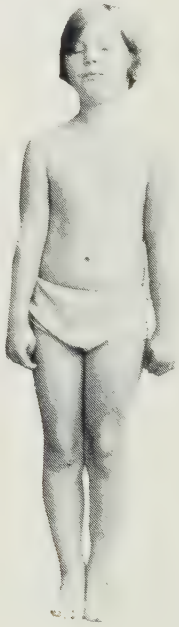


Fig. 21. Radiographic examinations in Mb. Blount of juvenile type.

Fig. 22. The severity of the changes in the medio-proximal part of the tibia is not always accompained by increased varus deformity.

A. 6 years old. The girl has no varus deformity, but X-ray shows metaphyseal stage. (Case No. 124).





B. 7 years 11 months old. The girl has no varus deformity, but X-ray shows epiphyseal stage. (Case No. 111.)

3) TIBIA-*plateau-diaphysis* = *angle 3* cannot be used in the infantile type because at this age the plateau of the tibia cannot be demonstrated radiographically.

4) FEMUR-*plateau-diaphysis* = *angle 4* measures abnormalities of the femur but not of the tibia.

None of the above angles were found to be useful in the definitive evaluation of the radiographic angle.

5) *The* FEMUR-*epiphysis*-TIBIA-*diaphysis* = *angle 5* was found to be useful for evaluation. An attempt to study the relation between this angle, angle 1 and the clinical angles at the last examination is given in Fig. 23 and Fig. 24.

3. Treatment

Conservative as well as *surgical* treatment has been tried. It is difficult to gather from the literature how this disease should best be treated. Published series are small and the treatment given and the results obtained are often incompletely described.

Conservative treatment has been recommended as a general principle, possibly with osteotomy in severe cases (Lasserre and Lasserre 1950, Alvik 1955, De Palma 1955, Tobin 1957), or conservative treatment for the infantile type, and osteotomy for the juvenile type (Gaily 1956, Herrara 1959, De Moraes and Perricone 1959, Rojas et al 1960, and Kurowska 1969).

The literature on Mb Blount contains only 5 conservatively treated cases with a complete description of treatment and end-results, *viz.* 2 patients treated with braces at an age of 2 years with good results (Blount 1937, 1966), 1 improved after wedge cast (Blount 1942), and 2 treated with a special supporting apparatus, with deterioration in one (Lamy and Weissman 1946) and improvement in the other (Aberle and Horstenegg 1956).

Spontaneous correction or decreased varus deformity has been reported in 10 cases (Lewin and Ritter 1929, Alvik 1955, Evensen and Steffensen 1957, Langenskiöld and Riska 1964, Blount 1966, Bateson 1966, Sevastikoglou and Eriksson 1967, and Fait 1970), while in 2 cases the varus deformity remained unchanged (Giaccai 1959, and Bateson 1966).

Surgical treatment. Gaily (1956) reported 2 cases operated upon with *stapling epiphyseodesis* with good results. Unfortunately nothing is mentioned about the age of the patients, the severity of the disease, or the angle of the varus deformity. *Epiphyseodesis according to Phemister* (1933) of the lateral tibia and fibula combined with tibia or also fibula osteotomy, has been described as successful (Langenskiöld and Riska 1964) in 9 knees.

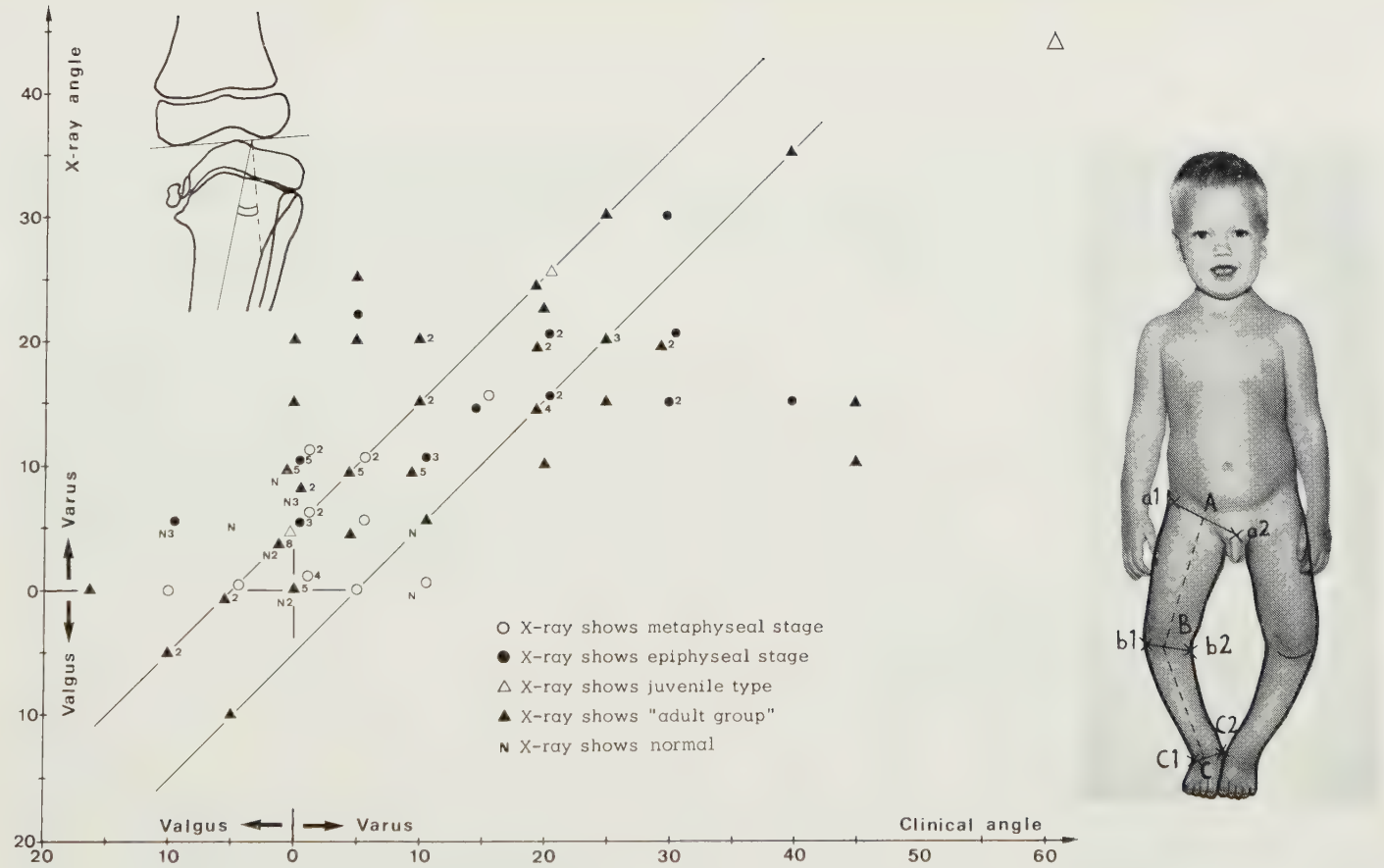


Fig. 23. The relation between the clinical angle and the radiographic angle 5 in 121 knees.

In 76 knees both angles were the same (range of variation ±5°).

In 13 knees the clinical angles were 10—35° more than the radiographic: In 3 of these knees the clinical angles were the same in recumbent and in standing position.

In 32 knees the radiographic angles were 7—20° more than the clinical: In 15 of these knees, a varying degree of bayonet appearance could be seen.

Digits indicate number of knees when more than one.

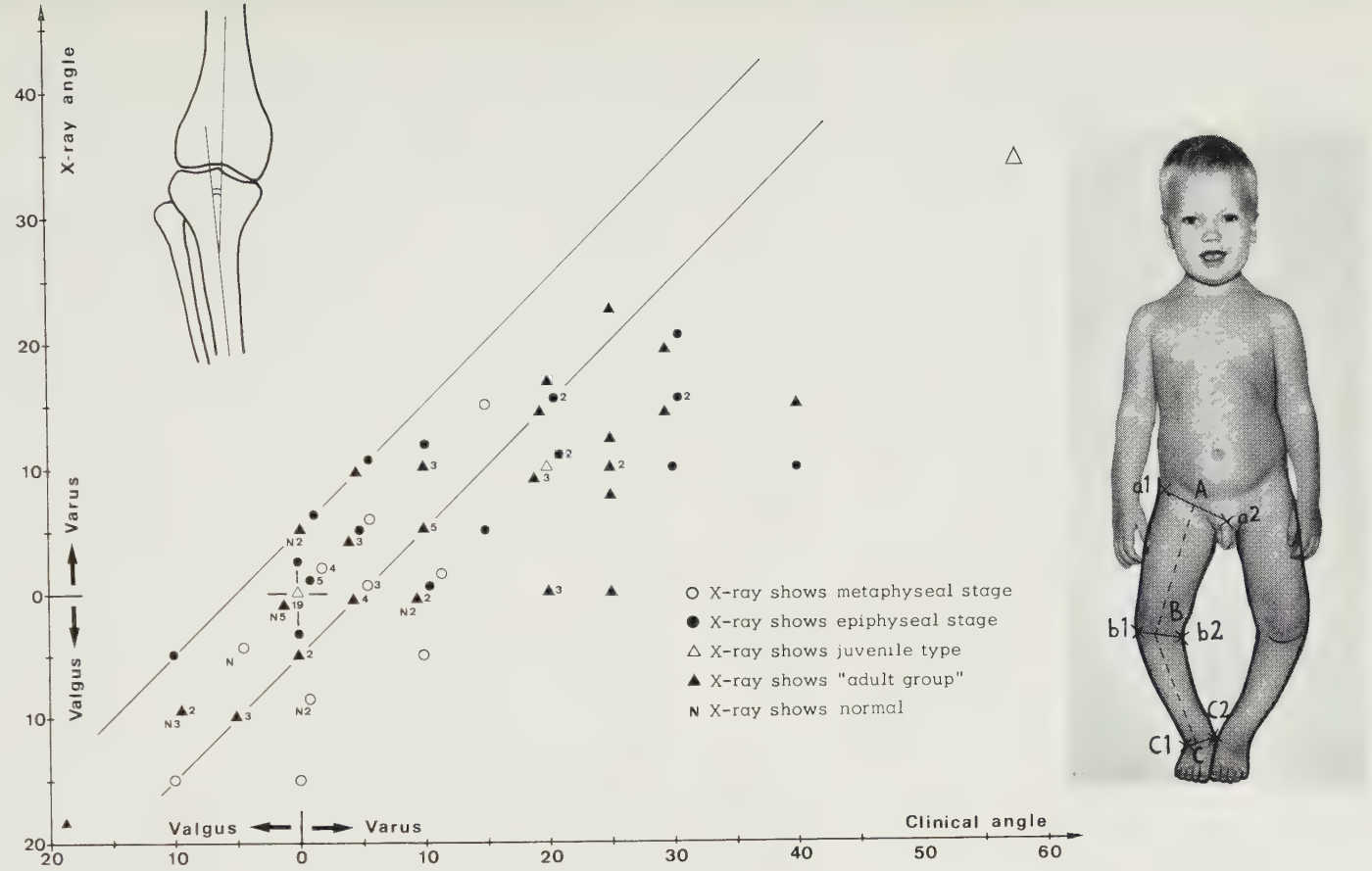


Fig. 24. The relation between the clinical angle and the radiographic angle 1 in 119 knees.

In 84 knees both angles were the same (range of variation ±5°).
In 35 knees the clinical angles were 10—25° larger than the radiographic: In 12 knees the clinical angles were larger in standing than in lying position.
Digits indicate number of knees when more than one.

and by Sevastikoglou and Eriksson (1967) in 2 knees. The age of these 11 patients ranged between 9 years and the end of the growth period.

The literature contains reports of 158 *osteotomies* specified regarding the patient's ages and the time of the operation and the end result. Of 96 cases operated upon with osteotomy *in 2—8 year old* patients good results were reported in 76 (Swart 1942, Michail et al 1959, Giaccai 1959, Medbö 1964, Langenskiöld and Riska 1964, Selivanov 1965, Blount 1966, Sevastikoglou and Eriksson 1967, Kessel 1970, and Fait and Saibert 1970), while recurrence of the varus deformity occured in 20 (Lewin and Ritter 1929, Evensen and Steffensen 1957, Langenskiöld and Riska 1964, Siffert and Katz 1970, and Fait and Saibert 1970). Of 51 patients operated upon with osteotomy at *8—14 years* good results were reported in 12, and recurrences in 39 (Rall 1929, Rocher and Roudil 1930, Blount 1937, 1966, Pouzet 1937, Pitzen and Marquart 1939, Barber 1939, Pascau 1939, Michail et al 1959, Medbö 1964, Langenskiöld and Riska 1964, Støren 1970, and Siffert and Katz 1970).

In 10 cases of juvenile type operated upon with osteotomy at *10—18 years* of age a 1—4 cm. shortening of the leg occurred (Langenskiöld and Riska 1964). One patient was successfully operated upon at 13 years with elevation of the medial condyle and filling the defect with a bone graft (Støren 1970).

Conservative treatment has been advised if the angle is less than 10° (Nechvolodova and Arenberg 1963, Langenskiöld and Riska 1964, and Zhitnitskii et al 1967), or 15° (Golding and McNeil Smith 1963), or 25° (Bateson 1966), and operation if the angle is larger.

EVALUATION OF TREATMENT IN THIS MATERIAL

a — Non-operative in 49 knees (35 patients).
b — Epiphysiodesis in 26 knees (18 patients).
c — Osteotomy in 56 knees (37 patients).

5 of the patients had bilateral Mb. Blount and were operated on one side and not on the other (3 with epiphysodesis and 2 with osteotomy).

The *results* were judged as regards clinical varus deformity, shortening of the leg, muscular atrophy, and recurvation. On the basis of the clinical findings at the last examination the material was divided into the following 4 groups:

Group I. Normal knees, i.e. up to 10° varus, valgus or recurvation, plus a *normal leg,* i.e. without shortening or muscle atrophy.

Group II. Normal knees (see group I), but *leg shortening,* with or without muscle atrophy.

Table 4. Result of non-operative redressement in Mb. Blount.

CASE No.	TREATMENT	RESULT	
46 Bilat.	Night-bandage at 3 Y age until 7 Y age.	I	I
151 Bilat.	At 2 Y 8 M of age: bilateral plaster with redressement under anesthesia. After 4 M special bandage with articulation and lock at the knee joint for 6 months.	III	III
161 Bilat.	Redressement + plaster under anesthesia: at age of 2 Y 2 M for 3 months.	I	I
162 Unilat.	Redressement + plaster for 3 months at 3 Y 3 M for age.		I

Group III. Abnormal knees, i.e. more than 10° varus, valgus or recurvation and *normal leg* (see group I).

Group IV. Abnormal knees (see group III), plus *leg* shortening, with or without muscle atrophy.

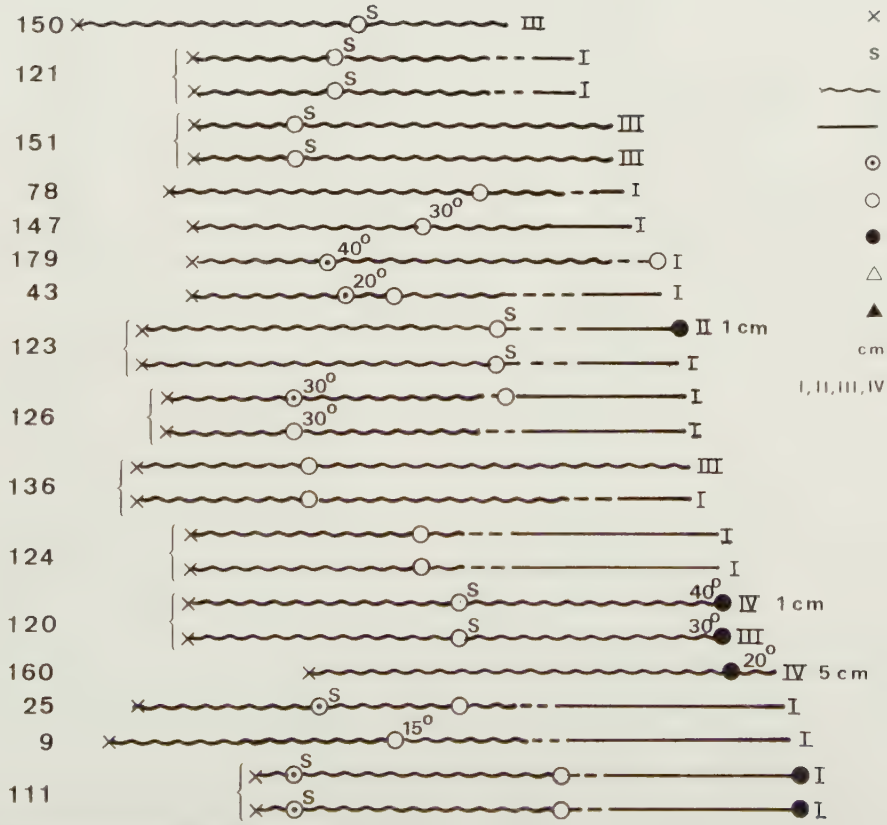
Attempts were made to use the radiographic varus angle (angle 5 in Fig. 11) instead of the clinical angle, but this proved impossible. The old radiograms taken in the 20s and 30s cannot be compared with those taken later because of differences in the projections used and in the quality of the films. This together with the fact that it was mainly the clinical varus angle that induced the patient to seek medical advice and that all earlier authors who have treated Mb. Blount used the clinical measurements, it was decided to use them in the evaluation of the results of treatment.

The material proved too small to analyze the effect of treatment in terms of different stages, different methods of treatment, age of the patients and severity of the clinical varus deformity. Therefore the analysis was made only with relation to the *age* of the patients and the *severity* of the clinical varus angle.

a — *Non-operative: 49 knees in 35 patients* (Fig. 25).

Only 12 knees had received conservative treatment as follows (see Table 4): in 5 knees the treatment consisted of an arch support, in 5 knees plaster redressement, and in 1 bilateral case night splints. The remaining 37 knees had no treatment at all.

Analysis of the end-results show that of the 39 *infantile* knees 28 knees



× Varus started
S Severe varus
Varus still existing
No varus
⊙ X-ray shows initial stage
○ X-ray shows metaphyseal stage
● X-ray shows epiphyseal stage
△ X-ray shows juvenile type
▲ X-ray shows "adult group"
cm Leg-shortening in centimeters
I, II, III, IV End-results

Fig. 25. 49 knees were not operated.

straightened (group I): the varus deformity started at about one year of age, it reached its maximum at about 2 years, and then subsided successively to disappear at about 4 years. In 4 of the knees, the patients had not been examined at the time of maximal deformity, while in 6 knees, the patients told that the deformity had already disappeared before the routine clinical examinations had been carried out, but X-rays proved the diagnosis. The time of observation counted from the time of maximal clinical deformity to the last examination was 1 year 7 months in 2 knees (bilateral case), 2—4 years in 8 knees, 4—8 years in 9 knees, 12—17 years in 5 knees, and 23—29 years in 4 knees.

Of the remaining 11 knees of the infantile type, 2 belonged to group II at 5 and 16 years of age, 6 to group III and 3 to group IV. However, 3 knees in group III were not yet 4 years old.

Of the 7 knees treated with plaster or night splints, one bilateral case deteriorated into group III and the other 5 knees improved to group I.

Conclusion: Spontaneous improvement thus can be expected in the infantile type before the age of 4. Whether or not treatment with plaster or splints had any effect on the condition could not be determined (see Case reports 3 and 4).

Of the *7 juvenile knees,* 2 knees (bilateral case) were assigned to group I; the patient asked medical help at 12 years age because of pain in the knees. 3 months later a slight varus could be noticed which subsided and had disappeared at the last examination — 2½ years later. In the remaining 5 knees, 3 were assigned to group II, and 2 to group IV. The varus deformity in these 5 knees started at 10—13½ years of age, and the age at last examination was 20—40 years.

Of the *3 adult knees* which developed from the juvenile type. 1 was assigned to group III and 2 to group IV. At the last examination the ages ranged between 33 and 49 years.

Conclusion: It seems that poor results can be expected if the juvenile type of Mb. Blount are left untreated (see Case report 5).

b — *Epiphysiodesis: 26 knees in 18 patients* (Fig. 26).

(Stapling according to Blount and Clark 1949 in 25 knees, and in 1 knee according to Phemister 1933.)

Analysis of the material revealed three categories of age groups.

Knees operated between 2 and 13 years of age gave good results (14 knees assigned to group I, 2 knees to group II and 1 to group IV). However

9 knees were operated at or before age 4 and all improved to group I. — Knees operated at 13—15 years of age gave mixed results: 2 knees were assigned to group I, 1 to group II, 2 to group III and 1 knee to group IV, probably reflecting the normal variation of the closure of the growth plate. Knees operated after 15 years age gave poor results: 2 knees were assigned to group III, and 1 knee to group IV.

The time of observation from the first operation to the last examination was 1—10 years, average about 5 years. The time from the first operation to adequat correction was about 3 years for the 16 knees which improved to group I.

Reoperation because of *slipping* of the staples was done in 7 knees, of which 2 were reoperated a second time. It seems that slipping of the staples did not have any effect on the end results because all were assigned to group I.

Conclusion: Counting only knees operated after age 4, but before closure of the growth plate, epiphysiodesis seemed to have a favourable effect on the angular deformity (see Case reports 6 and 7).

c — *Osteotomy: 56 knees in 37 patients* (Fig. 27).

Analysis of the material revealed three categories of age groups.

1) *21 knees operated at 2—7 years.*

15 knees were assigned to *group I:* the varus deformities at the time of operation were described as severe in 9 knees, only as varus in 2 knees, 25° in 1 knee, and 30° in 3 knees. The observation time counted from the day of the operation to the last examination was 4—12 years in 9 knees and 17—21 years in 6 knees. Only one knee was reoperated upon.

10 of the 15 knees which improved to group I were operated upon before age 4.

4 knees were assigned to *group II:* the varus deformities were described as severe in 1 knee, and 20—25° in 3 knees. The observation time was 6 years in 2 knees, and 20 years in 2 knees. 3 knees were reoperated upon.

2 knees were assigned to *group III* (bilateral case): the operation had been done at 4½ years of age because of 45° varus bilaterally. 2 years later the varus deformities had recurred.

Conclusion: It seemed clear that osteotomy before age 7 gave good results (see Case report 8).

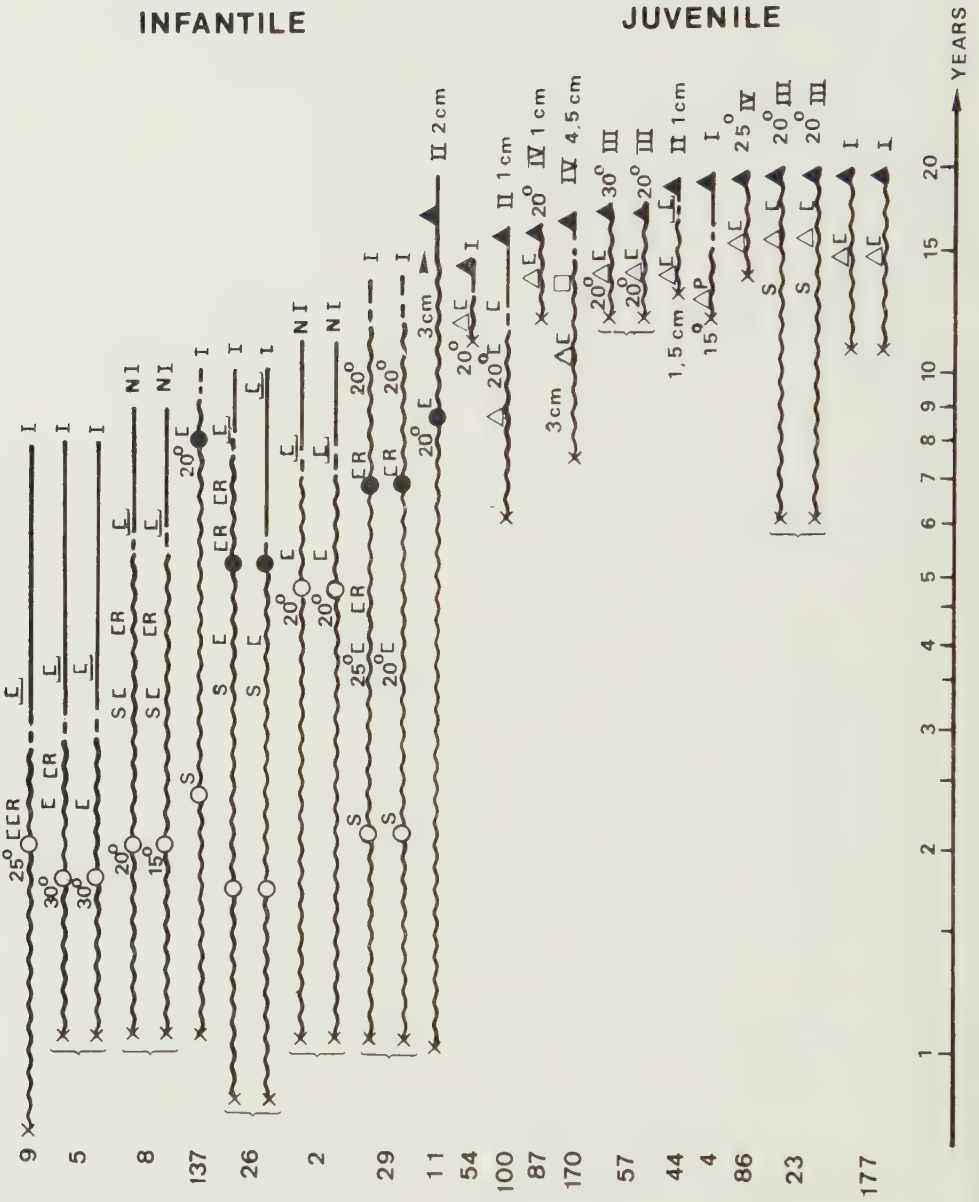


Fig. 26. 26 knees were treated by epiphysiodesis (25 by stapling and 1 by the Phemister-method).

2) *19 knees operated at 7—15 years.*

4 knees were assigned to *group I:* the varus deformities were described as 12°, 20°, and in two knees 30°. The observation time was 6 years on the average in 3 knees, while in the 4th knee the time was very short (only 2 months after the operation). No knee was reoperated upon.

1 knee which was assigned to *group II* had been operated at 13 years because of 20° varus and 3 cm. leg-shortening. The varus deformity disappeared, but 2 cm. leg-shortening was observed of age 24 years.

5 knees were assigned to *group III:* the varus deformities were described as severe in 3 knees, and 20° and 30° in 2 knees. The observation time was 4, 7, 12, and 36 years, respectively.

Reoperation had been done once on 2 knees, and twice on 2.

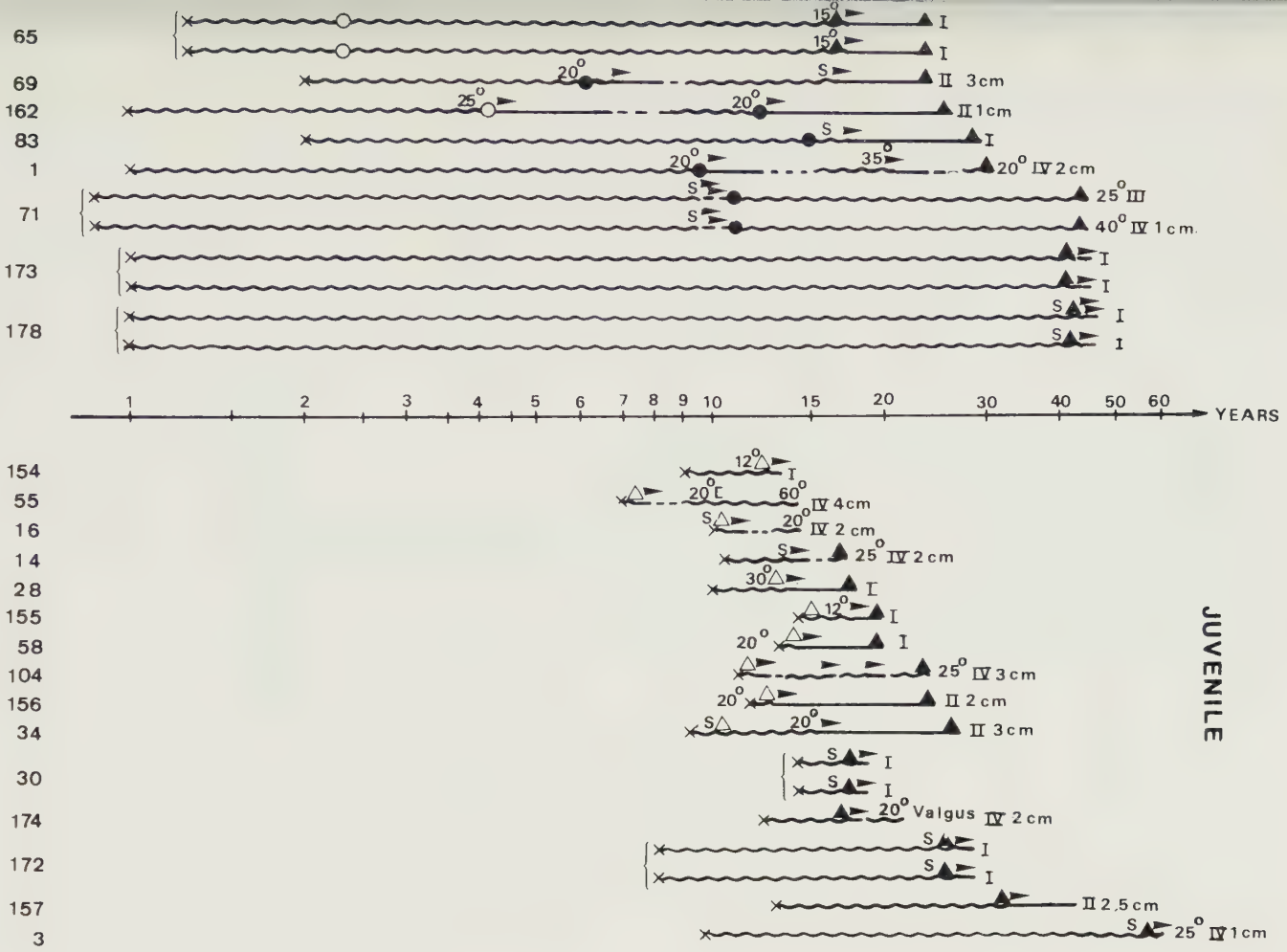
9 knees were assigned to *group IV:* the varus deformities were described as severe in 5 knees, as varus only in 2 knees, and 20° and 30° in 2 knees. The observation time was 3—8 years in 6 knees, 12, 22, and 36 years respectively in the remaining 3 knees. 5 knees were reoperated: once in 4 knees (in which 1 knee with epiphysiodesis and not osteotomy), and twice in 1 knee.

Conclusion: It seemed quite clear that osteotomy at age 7—15 years gave poor results with a risk of recurrency of the varus deformities in spite of reoperation (see Case report 9).

× Varus started

~~~ Varus still existing

S Severe varus

——— No varus

○ X-ray shows metaphyseal stage

● X-ray shows epiphyseal stage

△ X-ray shows juvenile type

N X-ray shows normal

C Stapling-epiphyseodesis

E Exstirpation of the staples

P Epiphyseodesis according to Phemister

⟜ Osteotomy

□ Stapling on medial and lateral distal contralateral femur to stop growth

I,II,III,IV End-results

cm Leg-shortening in centimeters
~~~

Fig. 27. 56 knees treated by osteotomy.


65
69
162
83
1
71
173
178
15° I
15° I
20° S II 3cm
25° 20° II 1cm
S I
20° 35° 20° IV 2cm
S 25° III
S 40° IV 1cm
I
I
S I
S I
1 2 3 4 5 6 7 8 9 10 15 20 30 40 50 60 YEARS
154
55
16
14
28
155
58
104
156
34
30
174
172
157
3
12° I
20° 60° IV 4cm
S 20° IV 2cm
S 25° IV 2cm
30° I
12° I
20° I
25° IV 3cm
20° II 2cm
S 20° II 3cm
S I
S I
20° Valgus IV 2cm
S I
S I
II 2,5cm
S 25° IV 1cm
JUVENILE

3) *16 knees operated after the age of 15 years.*

12 knees were assigned to *group I:* the varus deformities were described as severe in 7 knees, as varus only in 2 knees, and 12—15° in 3 knees. The observation time was ½—1 year in 4 knees, 2—3 years in 5 knees, and 7 years in 2 knees. 2 knees were reoperated because of recurrency of the varus deformity in one knee, and of nonunion in one knee.

2 knees were assigned to *group II:* in both knees, leg-shortening (2½ and 1 cm) had already been noticed at the time of operation with varus deformities described as severe in one, and as varus only in the other. The varus deformities disappeared but the leg-shortening still existed at the last examination at 10 and 11 years after the operation. No knee was reoperated.

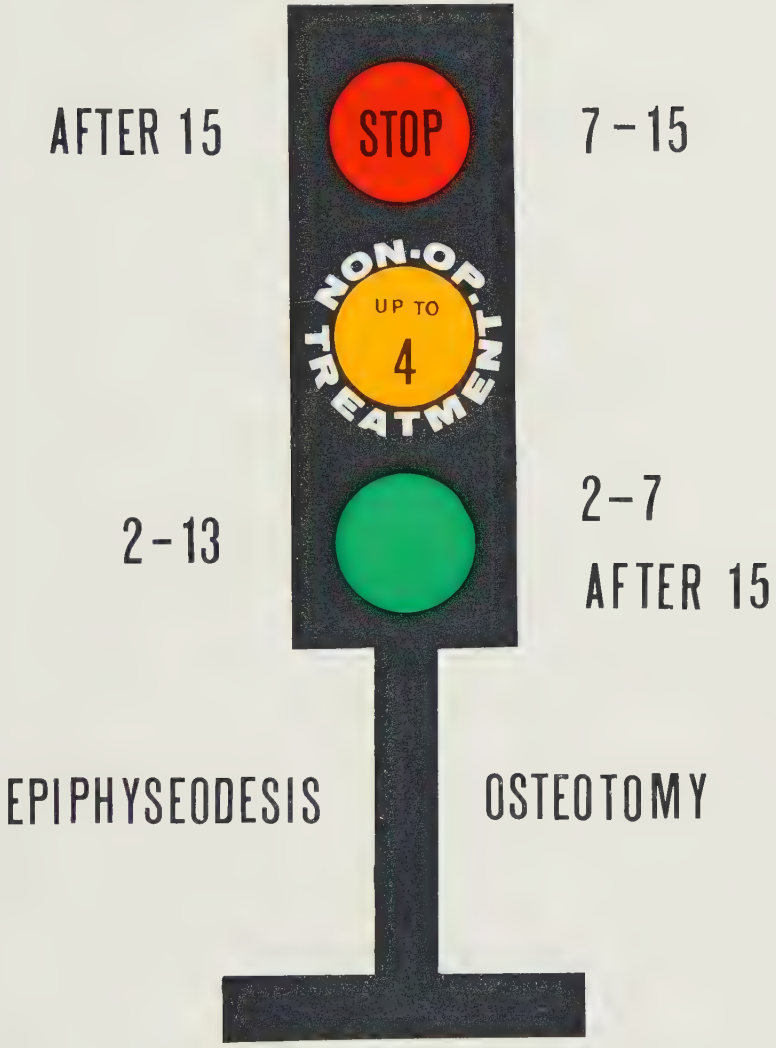
No knee was assigned to *group III.*

2 knees were assigned to *group IV:* one knee was operated at 59 years of age because of severe varus, which was not corrected adequately. The other knee was operated at 17 years of age because of "varus". The poor result was due to a severe postoperative infection with ischemic necrosis, severe muscle atrophy of both the thigh (4 cm.) and the calf (10 cm.), peroneal paresis, and 20° valgus with 2 cm. leg-shortening, see Case report 11.

Conclusion: It appeared that osteotomy after 15 years of age gives good results (see Case report 10).

The principles of treatment of Mb. Blount are illustrated in Fig. 28.

Fig. 28. The principles of treatment of Mb. Blount.



Non-operative treatment: up to 4 years of age.

Epiphyseodesis-stapling: between 2—13 years of age, but not after 15. Uncertain results between 13—15 years of age.

Osteotomy: between 2—7 years of age or after 15. Never between 7—15 years of age because oof recurrency.

V. Discussion and Conclusions

It is difficult, if not impossible, to tell exactly how many cases of true Mb. Blount that have been published, because some authors only state that they have seen a number of cases, but do not provide sufficient details concerning the basis of the diagnosis. Others have given detailed reports, but no reproductions of radiograms, which are crucial in a disease in which the diagnosis depends on both clinical and radiographic findings.

A search of the literature revealed 418 cases described as Mb. Blount (see Appendix B). Of these 133 are reported in detail with reproductions of radiograms, 27 with incomplete reports, but with reproductions of radiograms, 217 cases without reproductions of radiograms, but described briefly or in detail. In the opinion of the present author, 41 cases were not Mb. Blount, because the cases either had multiple deformities or were similar to the physiologic type of genu varum, or not properly documented, or had genu valgum instead of varum.

The disease is not so extremely rare as might be expected. Before publishing this thesis, the disease in Sweden was regarded as rare because only 5 cases had been reported.

Terminology

The names hitherto used to designate the disease are not entirely satisfactory. To call the disease after an author's name is debatable, because Erlacher (1922) was the first to report a typical case, while Blount (1937) was the first to identify the disease by a comprehensive clinical, radiographic and histologic investigation of the condition. However, the largest series (71 cases) has been published by Langenskiöld and Riska (1964). The designation "Tibia vara" says nothing about the actual site of the disease, i.e. whether the pathologic changes are located in the distal, proximal or middle part of the tibia. Tibia vara is a symptom and not a disease, and can be caused by other conditions such as fractures, osteomyelitis, tumor, rickets or congenital deformities (see Table 2). Moreover, it appears that the severe changes in the medial proximal part of the tibia are not always accompanied by a corresponding varus deformity in the proximal tibia (fig. 22). Therefore the word "deformans" is not appropriate in the designation "Osteochondrosis deformans tibiae".

Both tibia vara and osteochondrosis deformans tibia have been introduced to express the clinical deformity of the knee, but this is not always true. In Mb. Blount with bayonet knee, there is varus deformity in the proximal tibia but with valgus deformity in the distal femur the leg appears straight.

The designation to be used should describe the pathologic changes in the cartilage and bone *(osteochondrosis),* and the site of the disease *(tibiae).* Since the term (*Mb. Blount*) is so deeply rooted, and since Blount was the first to characterize the condition, it might be advisable to add Mb. Blount in brackets.

Differential diagnosis

The main problem encountered was to differentiate between the physiologic type of genu varum and the early (initial) stage of Mb. Blount. Both have exactly the same radiographic appearance. The problem can be solved by repeated radiographic control. The physiologic genu varum disappears spontaneously and therefore requires no treatment, while the initial stage in the infantile type of Mb. Blount progresses into other stages. Although rickets is now extremely rare in Sweden, 10 of the 85 cases of the material had been wrongly diagnosed as due to rickets, and later proved to be Mb. Blount. Vice versa, 8 cases regarded as Mb. Blount appeared to be rickets — 2 of them were cases of hypophosphatemic (vitamin D-refractory) rickets. The problem is that in healed rickets the varus deformity of the proximal tibia may be confused with the infantile type of Mb. Blount.

Incidence

The incidence of the condition was found to be about 5 new cases annually for a total of some 350 cases in the 8 million population of Sweden regarding the expectation of life is 70 years. The two types were equally common. The infantile type was about 50 % more common in girls whereas the juvenile type did not show any sex dominence.

Measurement of the varus deformity

No known clinical method can be accepted as ideal or accurate. Mikulicz (1879) and Böhm (1930) used the mechanical axis (weight-bearing), which passes through the femoral head, the middle of the knee, and continues down to the middle of the ankle. If this mechanical or weight-bearing line has shifted medially, genu varum is produced. This method of Mikulicz and Böhm cannot measure the degrees of the deformity with precision. Moreover, it is difficult to locate the femoral head in infants. Perkins (1961) stated that "a line drawn from the anterior superior iliac spine to the medial malleolus should normally cross the patella. When the line falls medially

to the knee joint, genu varum is present." Perkins method cannot measure the degree of the deformity with precision.

Some examiners measure the distance between the knees when the patient stands with the medial malleoli together (Mercer and Duthie 1964, Shands and Raney 1967). This method is not reliable, because sometimes, especially in obese patients, fatty pads on the inner side of the knee may mask or belittle the true severity of the deformity. Moreover, this method is a measure of the sum of the deformities on both sides and does not distinguish the individual knee deformities.

The author measured the varus angle formed by two lines passing from midinguinal and mid-trans-malleolar points, to the mid-knee point. It is easy to locate the mid-inguinal and mid trans-malleolar points, but it may be difficult to locate the mid-knee point with accuracy. This can be done by choosing the mid-point between the most prominent points of the femoral condyles, using the direction of the longitudinal axes of the thigh and leg as a guide (Fig. 8).

Radiography

As stated on page 26, standard projections according to Clark (1964) were used at the last examination, and the radiograms obtained were so similar in projection that they could be used in the study of the radiographic and clinical angles for any correlation. It might, of course, be ideal to use a very specialised X-ray technique with a TV-screen in order to get an exact projection (Norman 1972). However, the radiograms at the last examination were obtained in 23 different clinics with different resources.

The correlation between the clinical and the radiographic angles (angles 1 and 5 in fig. 11) at the last examination showed that these angles are not always identical. This means that one must specify and differentiate between the clinical and radiographic angles.

The author used the clinical angle when evaluating the end result of the cases.

As discussed on page 11, Langenskiöld's radiographic classification of the infantile type of Mb. Blount is complicated and describes different variants of a single entity. Therefore a simpler classification was introduced: initial, metaphyseal, epiphyseal and adult stages.

Etiology

It is obvious that the disease is a local manifestation affecting only the postero-medial part of the proximal tibia.

It would be of interest to know why the pathologic changes involve only the postero-medial part of the proximal tibia and not the lateral part as

well, nor the distal femur; why the deformity is often bilateral in the infantile type and unilateral in the juvenile type; why some cases regress without treatment and others progress if treated operatively; and why the radiographic and clinical angles do not vary with the severity of the disease.

Analysis of the present material showed that the patients in 16 cases of the infantile type and 4 of the juvenile type had one or more family members who had — during infancy — a genu varum deformity which more or less disappeared with time. In 4 of these infantile cases the patients were siblings (3 brothers and 1 sister). In 4 others (4 knees) with the juvenile type the deformity was said to have been preceded by trauma (distorsion in 1, contusion in 2, lateral collateral ligament damage in 1). Twelve of the patients have had infection (measles, whooping cough, mumps, infections of the respiratory tract). In 4 cases overweight had been noted in the records. Finally, 3 patients had had affections for which they had been operated upon: torticollis (1 case) or coarctation of the aorta (2 cases).

However, physiologic genu varum, minor trauma in childhood, measles, whooping cough, infection of the respiratory tract, are all common conditions in childhood and can hardly play a significiant role in the aetiology of Mb. Blount.

Histo-pathology

Only in one juvenile case (No. 54, at the age of 12 years) could a specimen from the beak be examined. It showed islands of cartilage and bone with collagen fibers. No sign of aseptic necrosis was observed.

Therapy

In some respects, the non-operated group, including cases treated with plaster and splints, is of great interest and possibly reflects the natural course of the disease. Only 5 cases treated conservatively have been reported in the literature (see page 57).

This material contained 49 non-operated knees (35 patients). It is the only available material hitherto of this type. Analysis showed that spontaneous improvement can be expected in the infantile type before the age of 4 years (28 out of 39 infantile knees). 4 out of 39 infantile knees still have varus, but they were not yet 4 years old at the last examination. The remaining 7 infantile knees — with poor results — were over 4 years of age (5—16 years). If we use the non-operated group as control material, and compare it, first with the stapling-epiphysiodesis group (26 knees in 18 patients, but in 1 knee only by Phemister epiphysiodesis) it was found that 9 knees stapled at or before 4 years were straightened. The question is whether these knees would had been cured if nothing had been done. Six

knees stapled at 13—15 years of age gave mixed results, probably reflecting the normal variation of the closure of the growth plate, while stapling of 3 knees after 15 years of age was totally ineffective as might be expected. The best result was obtained in the remaining 8 knees operated upon between 4 and 13 years of age. The varus deformity was corrected in all cases, but with leg-shortening in 2 juvenile and 1 infantile knees.

When discussing osteotomy, one must consider the works of Trueta (1957), Blount (1957), Langenskiöld (1957), Jansen (1957), and Emnéus and Hedström (1964) which showed that a fracture or similar trauma of a long bone in a child will often stimulate growth in length. If we do osteotomy (artificial fracture) in a child with Mb. Blount, it might stimulate the physis (growth plate), and if the medial part is abnormal, it will stimulate the lateral part with progression of the varus angle as a result. This probably explains why the results of osteotomy at 8—15 years gave such bad results, which was noticed in 15 out of 19 knees of the present material, and in 39 out of 51 knees reported in the literature.

Epiphysiodesis-stapling appears to be a minor and more physiologic operation than osteotomy, not least because of its temporary nature.

VI. Summary

131 knees with Mb. Blount in 85 patients were collected from 22 Swedish hospitals. 52 patients (91 knees) were of the infantile type and 33 (40 knees) of the juvenile type according to Blount (1937) and Langenskiöld (1952). 35 were male and 50 female. Of the 52 infantile cases, 39 were bilateral, and of the 33 juvenile cases, 7 were bilateral. The varus deformity in the infantile type was discovered at an age of, on the average, 1 year; in the juvenile type, between 6 and 14 years, on the average 11 years. The incidence of Mb. Blount was found to be about 5 new cases annually in the 8 million population of Sweden. Regarding the expectation of life in Sweden is 70 years, the total of some is 350 cases in the entire country. The two types were equally common. The infantile type was 50 % more common in girls whereas the juvenile type did not show any sex dominence.

It was found that the infantile type has 4 radioographic stages, the *initial stage* which is identical with the physiologic type of genu varum, the *metaphyseal stage,* the *epiphyseal stage* when the epiphysis grows down in the depression formed in the metaphysis, and finally the *adult stage* when growth is completed. The relation between the X-ray varus angles and the clinical angles was studied.

The two types of the disease differ in time of onset and radiographic appearance. Conservative treatment by splints, or only expectant treatment is suitable for young children up to 4 years old, irrespective of the degree of varus deformity. In children between 4 and 13 years of age stapling-epiphysiodesis of the lateral-proximal tibia is the method of choice. It is a minor operation and the staples can be extracted when the deformity has been corrected. Osteotomy can be used in children between 4 and 7 years, but osteotomy is contraindicated between 8—15 years of age because of the risk of recurrency. Osteotomy is the method of choise after the age of 15 years.

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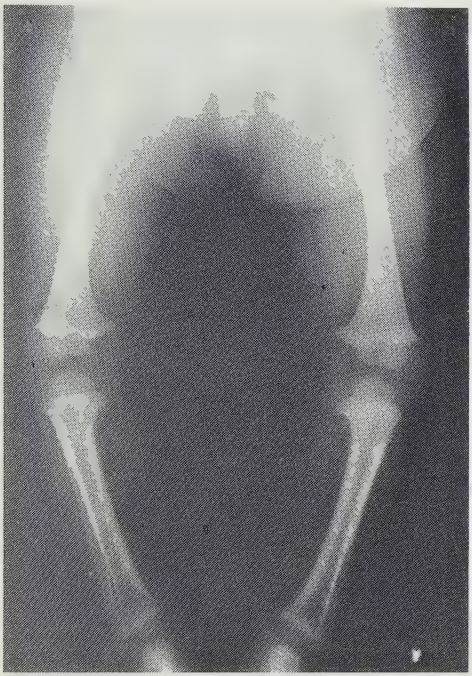
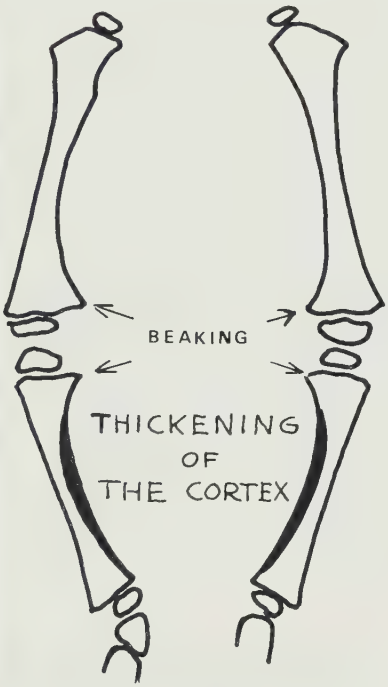
Case Reports

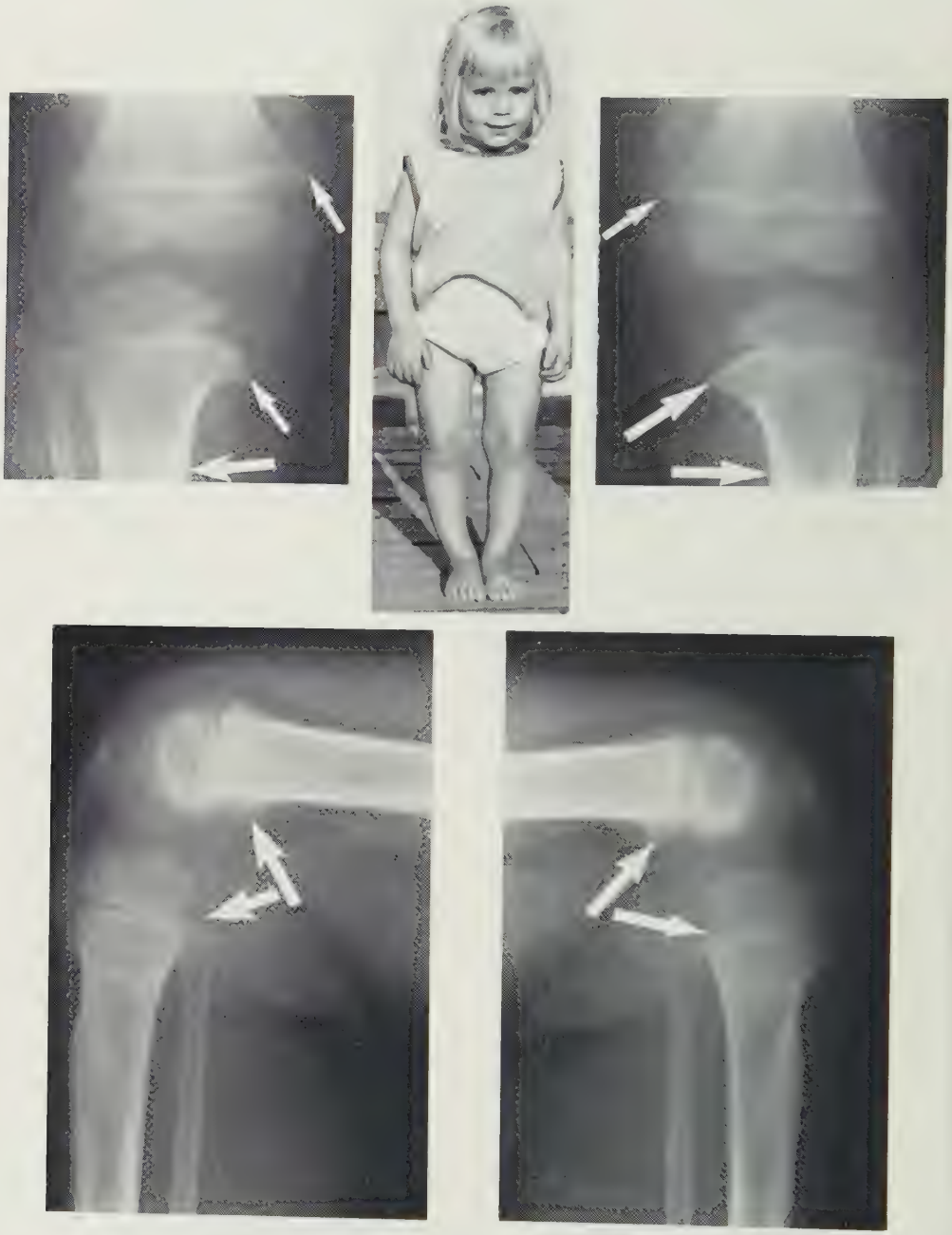
Case report 1 (Case No. 102). Physiologic genu varum.
The deformity disappears spontaneously and therefore requires no treatment.





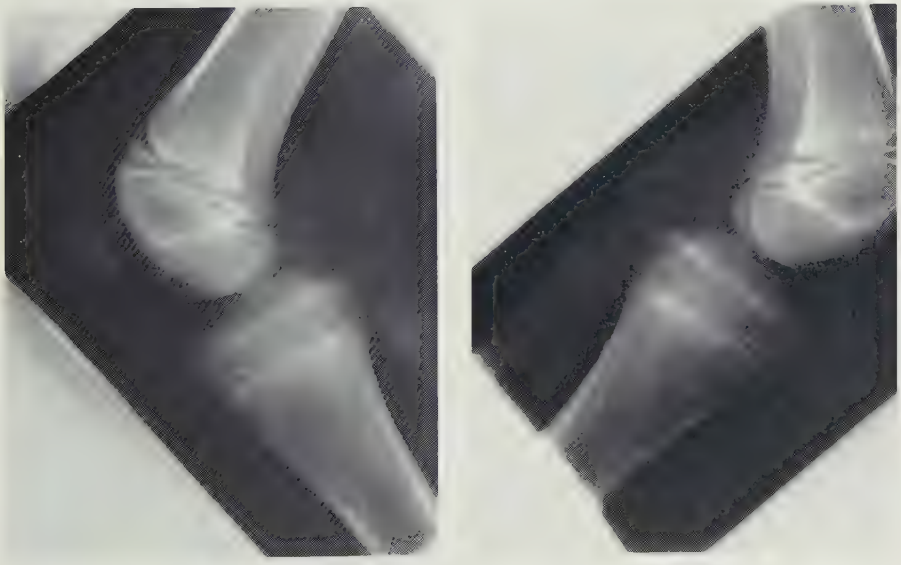
There is "Stress phenomenon" i.e.:
In the frontal view: a medial *beaking* of the femoral and tibial metaphysis, *thickening* of the medial cortical walls of the tibiae, and a certain reduction in size of the distal femoral epiphysis, which together with the tibial epiphysis is often wedge-shaped and tapers medially.

1 year 4 months old. Severe bilateral varus.



Regress of the varus deformity. 2 years 7 months old. There is beaking of the femoral and tibial metaphys.

Case report 1 (Case No. 102), continued



The varus deformity disappeared, normal radiography. 7 years 5 months old.

Case report 2 (Case No. 41)

It is impossible radiographically to distinguish between physiologic genu varum and the initial stage of Mb Blount. Differentiation requires radiographic follow up.
Right knee: physiologic genu varum.

1 year 4 months.

2 years.

4 years — normal.

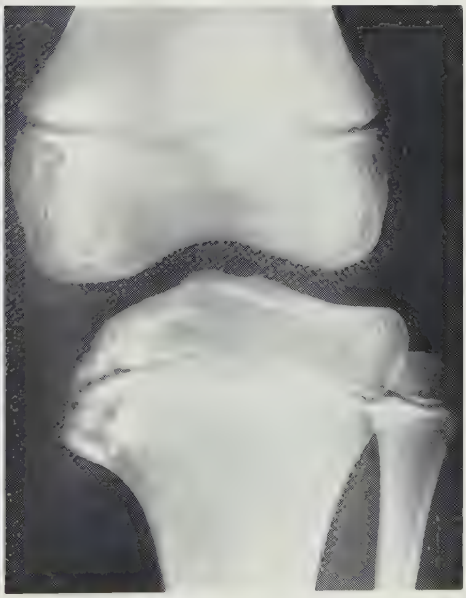
Case report 2 (Case No. 41), continued

Left knee: Mb. Blount.

1 year 4 months. Initial stage.

2 years. Metaphyseal stage.

4 years. Metaphyseal stage.



7 years 2 months. Epiphyseal stage.

Case report 3 (Case No. 25).

Spontaneous improvement can be expected in the infantile type before the age of 4.

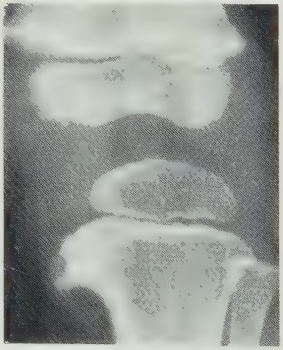
Physiologic genu varum

Metaphyseal stage of Mb. Blount

Clinically: Bilateral genu varum — severe on the left side. The distance between the knees was 5 cm. at 1 year 7 months.

Normal

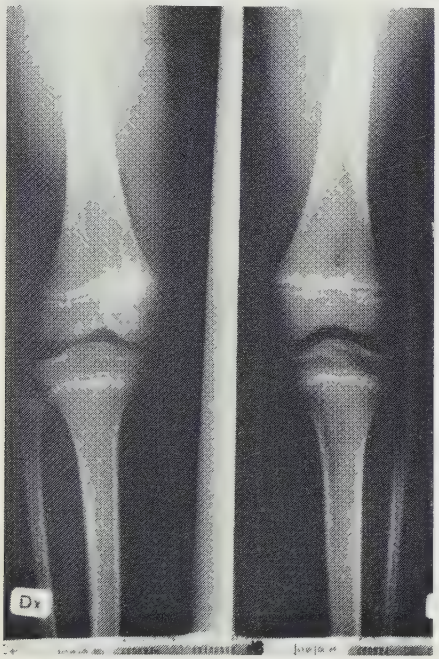
2 years 5 months

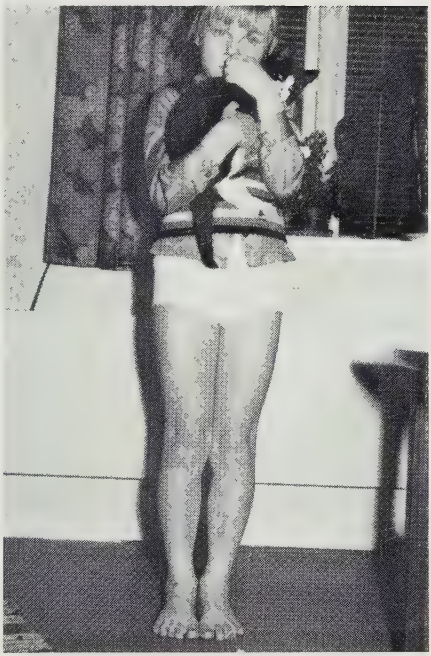


Metaphyseal stage of Mb. Blount

25° varus left, 5° right, the distance between the knees is 3 cm.

The varus deformities disappeared at 3 years of age.



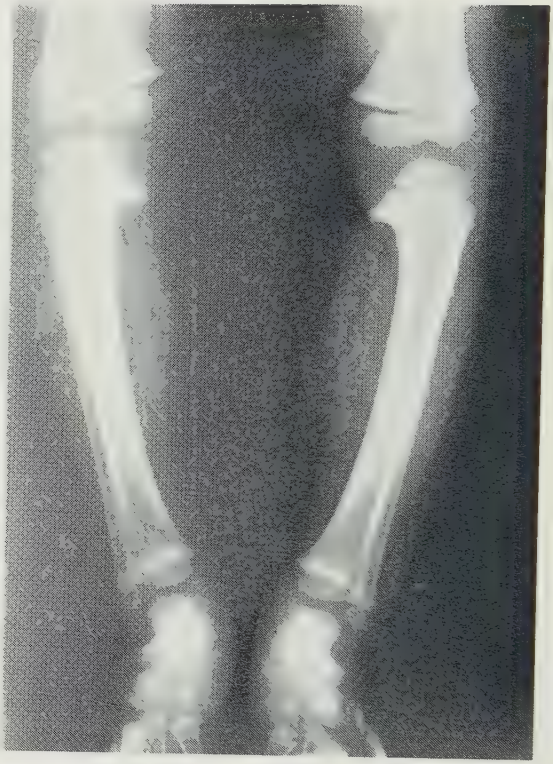


7 years 5 months

Clinical and radiographic examination revealed no abnormalities.

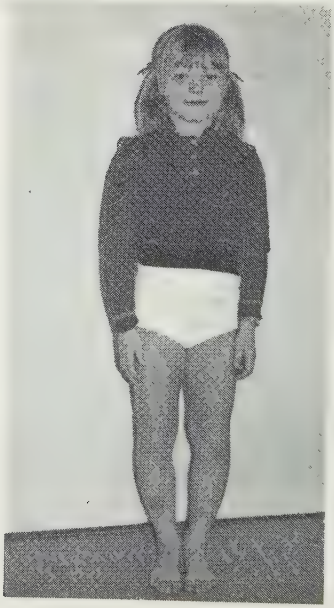
Case report 4 (Case No. 149).

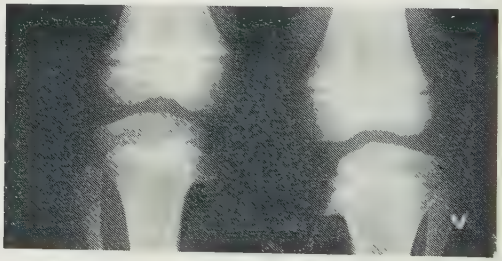
Poor result can be expected in the infantile type after the age of 4 if left untreated.



2 years 11 months. Bilateral metaphyseal stage.

Clinically severe bilateral varus.





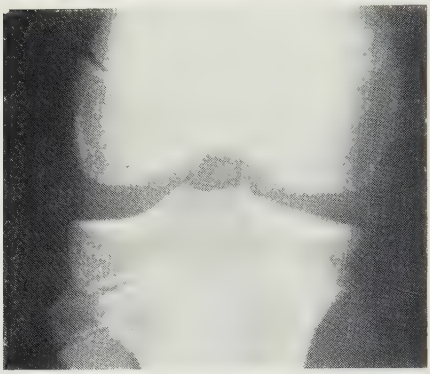
7 years 3 months. Still bilateral metaphyseal stage with bilateral clinical varus.

9 years 7 months.

Clinically: 20° varus right and 30° left. *Radiography:* Bilateral epiphyseal stage.

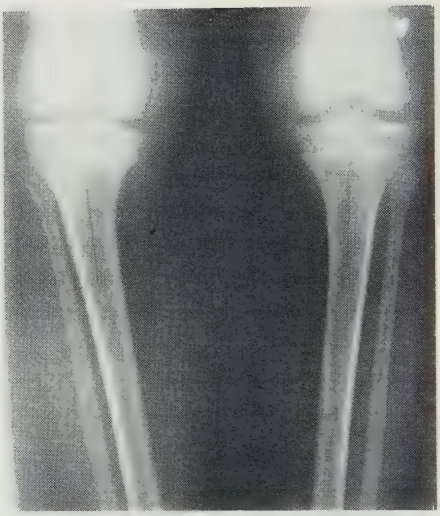
Case report 5 (Case No. 171).

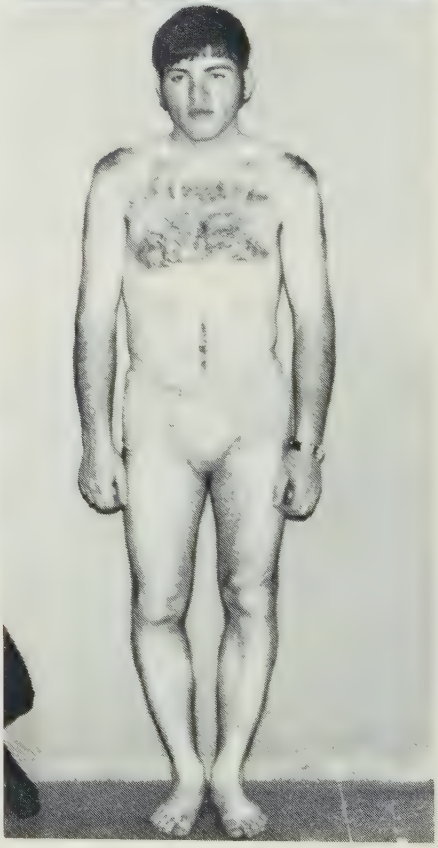
Poor result can be expected in the juvenile type if left untreated.



Juvenile type at 14 years. Varus deformity right knee, with 1 cm leg shortening.

No treatment.

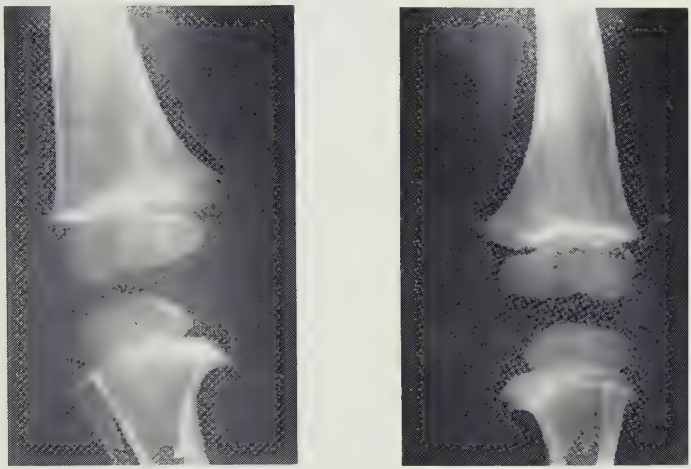




At 24 years 15° clinical varus deformity with 1.5 cm leg shortening and 1.5 cm thigh atrophy, the distance between the knees is 7.5 cm.

Case report 6 (Case No. 26).

Good result in the infantile type when treated with stapling-epiphysiodesis after the age of 4.

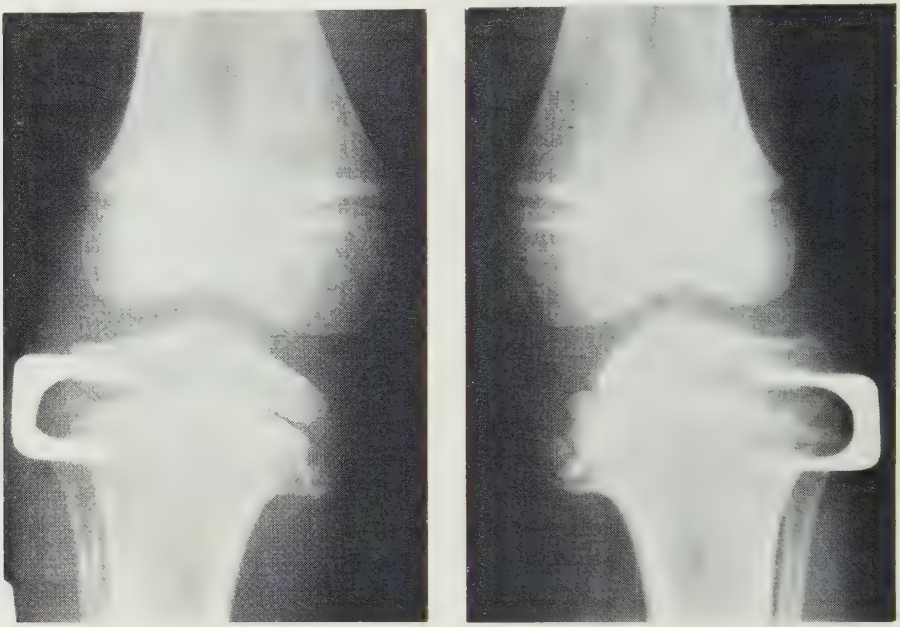


1 year 9 months. Clinically bilateral genu varum, the distance between the knees is 12 cm. Radiograms show metaphyseal stage.

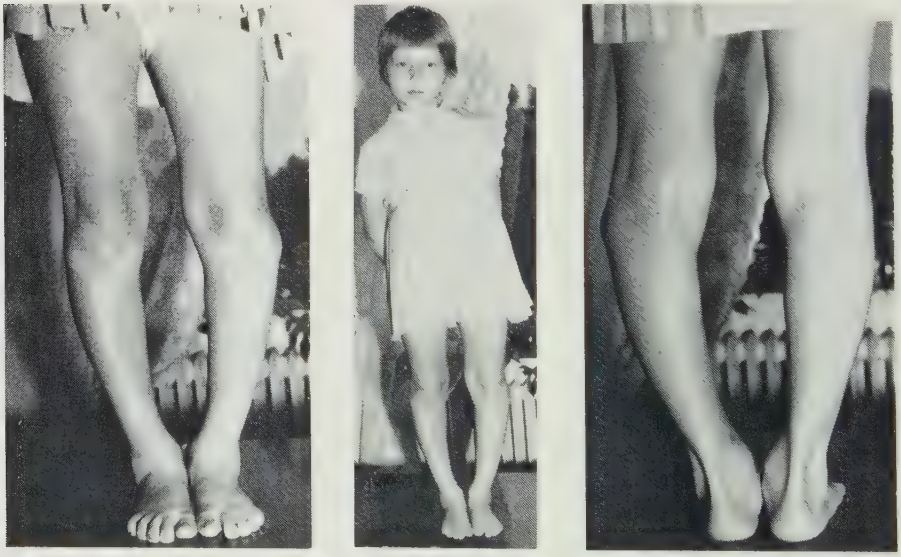
3 years 9 months. Clinically moderate varus on the right side, and severe on the left. The distance between the knees is 8 cm. Still metaphyseal stage.

Case report 6 (Case No. 26), continued

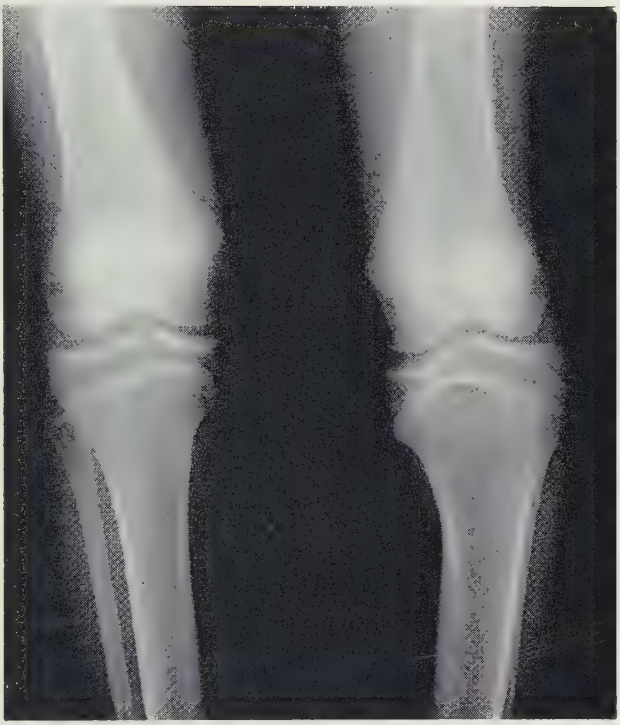
The child had been operated at 4 years of age with bilateral stapling epiphysiodesis, the left side reoperated upon at ages of 5 years 6 months and 6 years 4 months.



Radiograms at 5 years 2 months show epiphyseal stage. Clinically the child now had 10° varus right and 25° left with 1 cm shortening of the left leg.



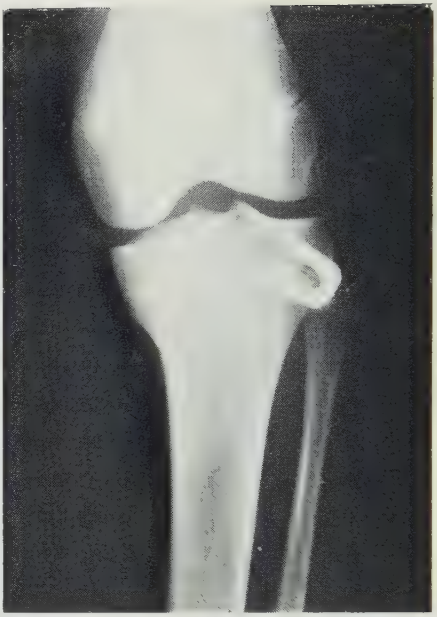
The staples were removed at age 8 (the left side) and 9 years 5 months (the right side).



10 years 8 months. Clinically: 10° valgus right and 10° varus left. 10° bilateral recurvation. Radiograms show epiphyseal stage.

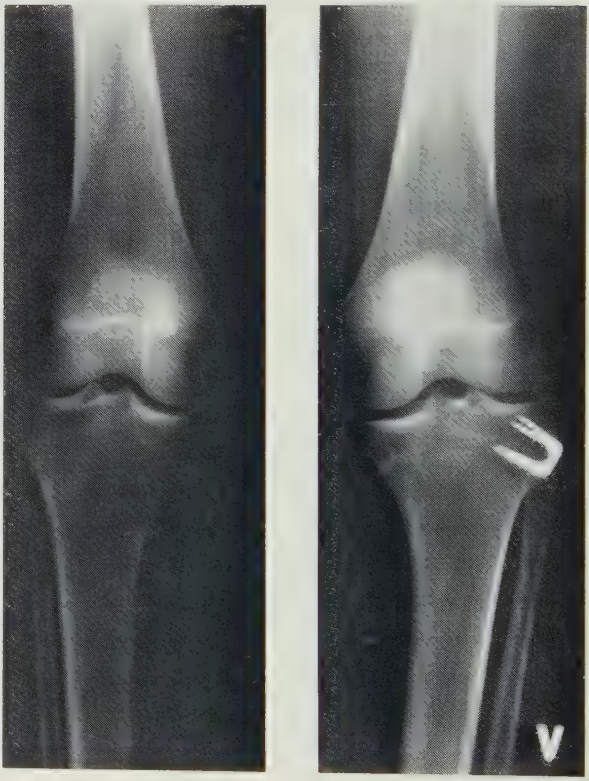
Case report 7 (Case No. 54).

Good result in the juvenile type when treated with stapling-epiphysiodesis up to age 13.



The left knee was operated with stapling epiphysiodesis because of 20° varus at 12 years 3 months.

14 years 8 months.
Clinically normal.



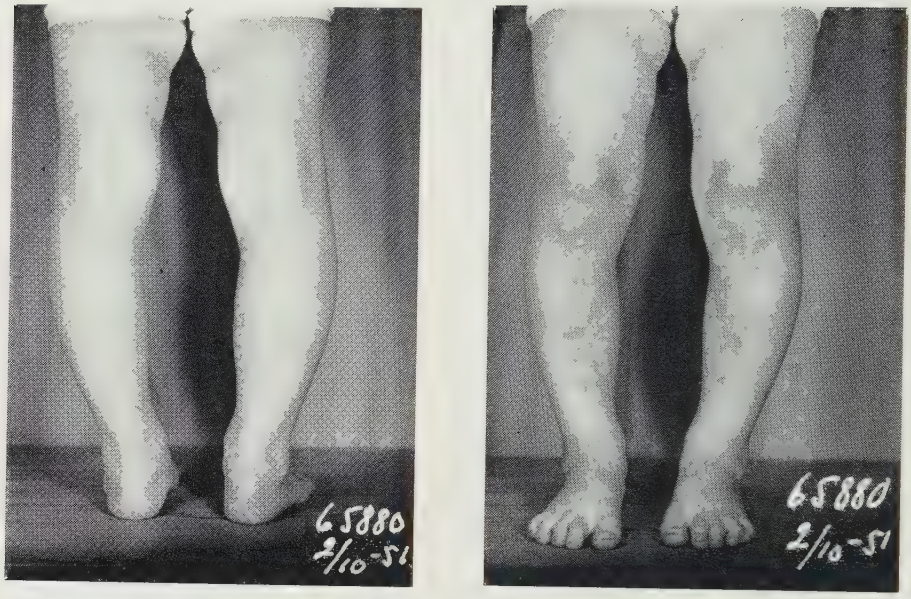
Case report 8 (Case No. 74).

Bilateral infantile type. Osteotomy before age 7 gives good result.

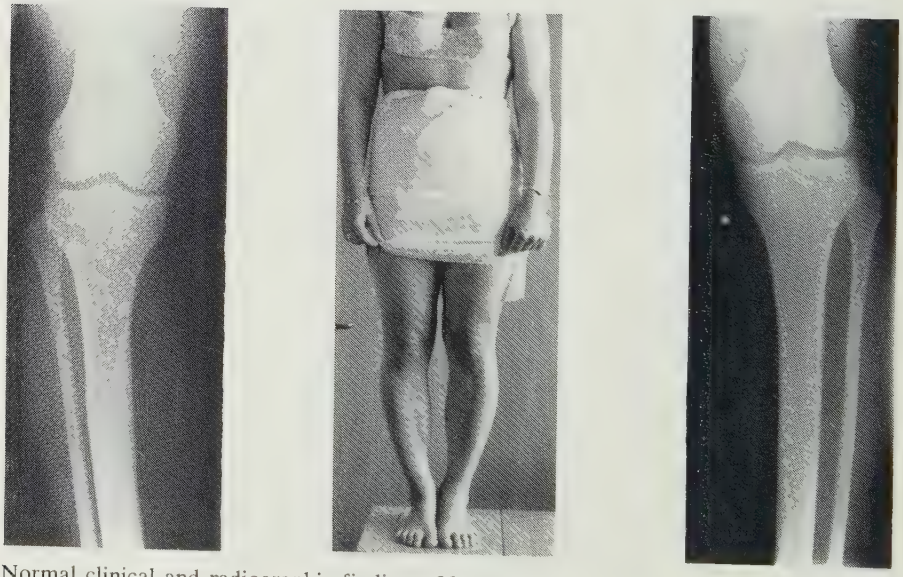
Severe bilateral genu varum. 2 years 4 months.

3 years 2 months.
Bilateral metaphyseal stage.

3 months after bilateral osteotomy.

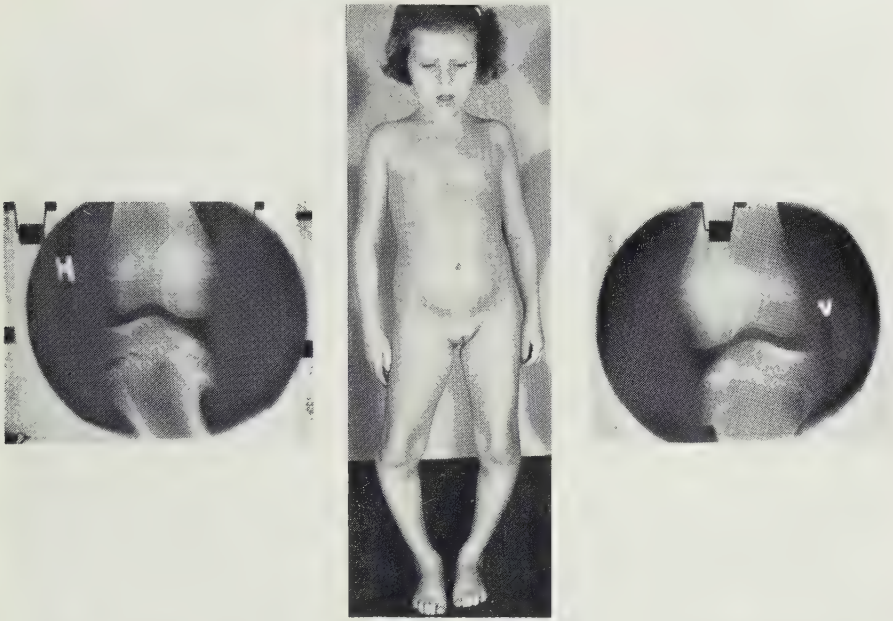


4 years 2 months

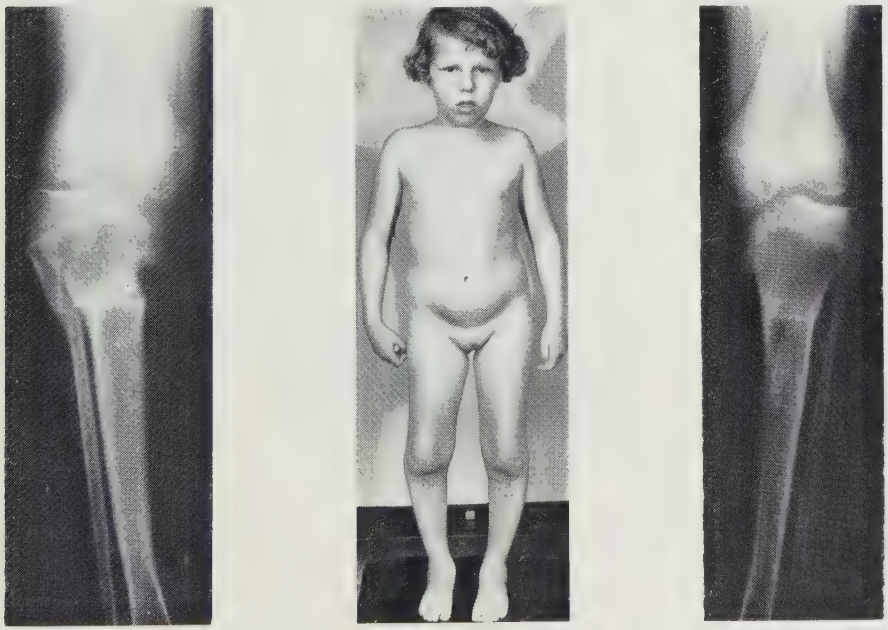


Normal clinical and radiographic findings. 20 years 2 months.

Case report 9 (Case No. 31). Bilateral infantile type.
Osteotomy at age 7—15 years gives poor result.



7 years 10 months. Genu varum — 30° right and 20° left. Radiograms show epiphyseal stage. The first bilateral osteotomy was done at 7 years 11 months.



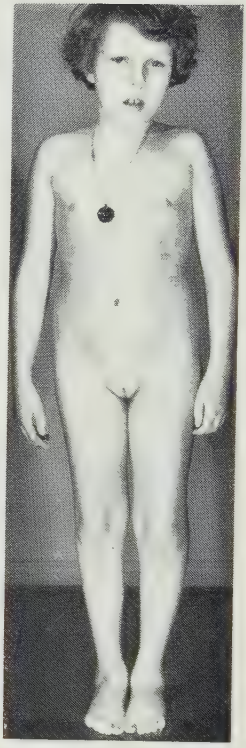
8 years 1 month.

Case report 9 (Case No. 31), continued

The second bilateral osteotomy was done at 9 years 10 months.

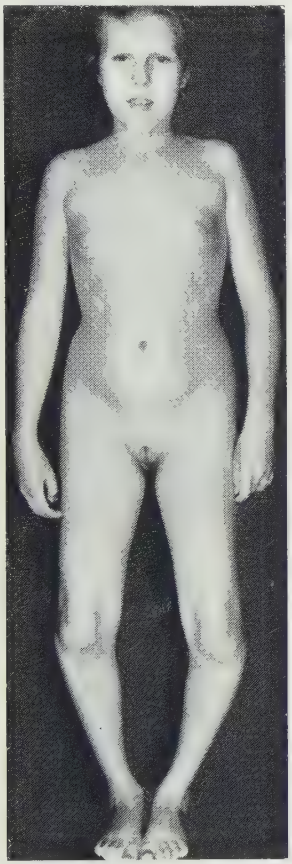
9 years 10 months.
Recurrence.

11 years 5 months.



10 years 1 month.

The third bilateral osteotomy was done at 12 years 4 months.



12 years 4 months.
Recurrence.

12 years 8 months.

20 years 2 months. Genu varum 25° right, 20° left.

Case report 10 (Case No. 65).

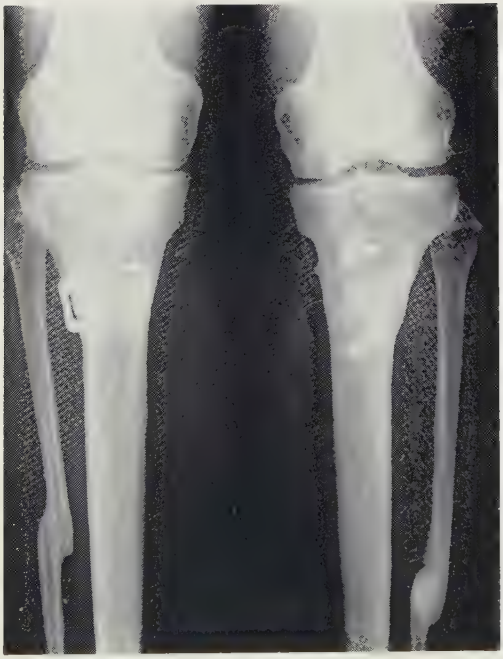
— Bilateral infantile type.

Osteotomy after 15 years of age gives good result.

Bilateral osteotomy had been done at the age of 16 years 8 months on the right side and at 16 years 10 months on the left reoperated at 17 years 5 months because of pseudoarthrosis.

16 years 5 months old.
15° bilateral varus.

23 years 9 months old.



Normal.

IX. Appendices

A. Material in code form

N.B. For Symbols and Abbreviations, see folded page at the end of the book.

1	2 — AGE			3 — CLINICAL EXAMINATION										4 — Radio-graphy	5 — TREATMENT			
	2^1	2^2	2^3	3^1	3^2	3^3	3^4	3^5	3^6	3^7	3^8	3^9	3^{10}		5^1	5^2	5^3	5^4
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+—					—0°							—1C		—5°N			I	

,, 59	.10	9.	12.9	..	+20°	+0°	+10°	....	—	5	—2	....	X	+20°E	....	+9.	T♂▶·◀♂T	+12
+—					—30°	—20°	—20°						X	—30°E		—9.	f— —f	—12
																	III IV	
, 163	1.	7.	12.9	..	+0°	....	....	....	....	1	—2	....	X	+5°E	....	+7.1	T[▶]·≫]T	+12
+—					—0°								X	—5°E		—7.2	F— —F	—8
																	I II	
, 164	1.	7.	12.9	..	+5°	....	....	....	....	2	+3	....	X	+22°E	....	+7.1	T[▶]·≫]T	+16
+—					—0°								X	—10°E		+12.	F— —F	—16
																—7.2	T▶·	—12
																	F—	
																	even compression	
																	a.m. Chanrley.	
																	II I	
,, 29	1.1	2.1	13.7	..	+0°	....	....	....	....	....	....	....	..	+10°E	....	+3.10	[[T·T]]	....
+—					—0°									—5°E		—3.10	I I	
, 46	1.1	2.2	14.5	..	+5°	....	....	....	....	....	....	....	X	+5°N	+ I	....	.....	....
+—					—10°								X	—5°N	— I			
,, 60	.11	2.10	14.9	..	+10°	....	....	....	....	2	....	....	X	+5°N	....	+3.	T▶·◀T	+10
+—					—10°								X	—0°N		—2.11	f— —f	—12
																—7.5	·—Tf	—14
																	I I	
, 12	1.	1.6	15.10	..	+20°	+10°	....	+	+	4	+1	....	..	+20°E	....	+8.1	T▶·◀T	+6
+—					—15°	—0°								—15°E		—8.1	f— —f	—6
																	IV III	
, 165	1.	10.	16.3	..	+5°	....	....	....	....	2	+1	....	X	+10°A	+ II	....	.....	....
+—					—0°								X	—8°A	— I			
,, 15	.11	10.	17.2	..	+20°	+20°	....	+	....	....	—1	....	..	+16°A	....	+10.	T—·—T	+9
+—					—20°	—30°		—						—16°A		—10.		—9
																—12.	bone chips>T	—10
																	III IV	

1	2 — AGE			3 — CLINICAL EXAMINATION										4 — Radio-graphy	5 — TREATMENT			
	2^1	2^2	2^3	3^1	3^2	3^3	3^4	3^5	3^6	3^7	3^8	3^9	3^{10}		5^1	5^2	5^3	5^4
11 +—	1.	8.6	18.10	..	+10° —5°	....	....	....	+	5	+2	+1Q +2C	X X	+10°A —10°A	— I	+8.7 +14.7	[[T· T▶· F— II	+6
114 +—	1.	3.3	19.1	..	+0° —0°	....	....	....	....	....	....	....	..	+.... —....	+ I — I	....	.....	....
74 +—	1.	2.4	20.2	..	+10° —10°	....	....	....	....	4	....	....	X X	+10°A —5°A	....	+3.2 —3.2	T▶·◀T f— —f I I	+12 —12
31 +—	1.2	7.10	20.2	+ —	+25° —20°	+30° —30°	+20° —20°	....	....	6	....	....	X X	+15°A —25°A	....	+7.11 —7.11	T▶·◀T F—	+9 —9
																+9.11 —9.11	T▌▶·◀▌T F— —F	+8 —4
																+12.4 —12.4	T▶·◀T F— —F III III	+8 —8
81 +—	1.1	2.2	22.8	+ —	+10° —10°	....	....	....	....	4	....	....	X X	+20°A —20°A	....	+3.10 —3.10	T▶·◀T f— —f I I	+6 —6
85 +—	1.	2.7	23.3	..	+10° —10°	....	+0° —20°	....	....	6	....	....	..	+6°A —4°A	....	+2.7 —2.7	T▶·◀T f— —f I I	+8 —8
65 +—	1.3	2.3	23.9	+ —	+0° —0°	+10° —0°	....	....	....	....	....	....	X X	+5°A —5°A	....	+16.8 —16.10 —17.5	T[[▶·◀]]T f— —f .Op. : ▌ pseudoarthros I I	+8 —5 —12

69	2.	6.	23.10	+	+0°	+10°	....	....	+	....	+3	+4Q	..	+20°A	....	+6.10	T♂▶.		+15
+																	F—		
																+16.4	T[[▶.		+16
																	F—		
																	II		
161	1.	1.8	25.4	..	+0°	....	....	....	....	....	....	....	..	+5°A	+ I	....	.....		....
+—					—0°									—5°A	— I				
162	1.	3.3	26.9	..	+5°	....	. ..	....	....	1	—1½	—4Q	X	+10°A	+ I	—4.4	.—T		—6
+—					—5°							—1C	X	—0°A		—11.11	.◀T		—8
					◡												& Phemister.		
																	—F		
																—12.5	.TF :		
																	Phemister-lat. because of valgus.		
																	II		
83	2.	14.7	29.	+	+10°	+10°	....	....	....	2	....	....	X	+15°A	⌒ I	+15.4	T≪▌.		+16
+—				—	—10°	—10°								—15°A			I		
I	1.	9.6	31.	+	+20°	....	+20°	....	....	6	+2	+2Q	..	+20°A	— I	+9.6	T—.		+18
+—				—	—0°		—20°					+3C		—....		+21.	T▶.		+12
																	F—		
																	IV		
71	.10	9.2	44.10	+	+40°	....	....	....	....	5	+ 1	....	X	+35°A	....	+9.2	T▶.	◀T	+6
+—				—	—25°								X	—20°A		—9.2			—6
																+9.5	T▶.	◀T	+ 7
																—9.5			—7
																	IV	III	
173	1.	41.	44.10	..	+0°	....	....	....	....	1	....	....	..	+6°A	....	+42.7	T▶.	◀T	....
+—					—0°									—6°A		—42.	♂	,,	
																		—F	
																	I	I	

1	2 — AGE			3 — CLINICAL EXAMINATION										4 — Radiography	5 — TREATMENT			
	2^1	2^2	2^3	3^1	3^2	3^3	3^4	3^5	3^6	3^7	3^8	3^9	3^{10}		5^1	5^2	5^3	5^4
178 +—	1.	42.10	45.3	+ —	+5° —5°	....	....	....	....	....	....	....	..	+0°A —10°A	....	+43.4 —43.3 —44.6	T[▶].[◀]T F— .[[◀]]T —F I I	+6 —6
154 —	9.	12.4	12.8	—	—0°	....	....	....	....	....	....	....	..	—5° J	....	—12.6	.◀]T —F I	—8
55 —	7.	7.4	14.	—	—60°	—20°	—30°	—	—	14	—4	—1Q —1C	X	—45° J	....	—7.4 —10.5	.◀T —f .T]]] IV	—8 —3
16 —	10.	10.5	14.	..	—20°	—35°	....	....	—	3	—2	—1Q —2C	X	—25° J	....	—10.7	.—T IV	—8
148 +—	11.10	12.1	14.6	+ —	+0° —0°	....	....	....	....	....	....	....	..	+10°A —10°A	+ I — I	....	.....	....
54 —	11.	12.1	14.8	—	—0°	....	....	....	....	....	....	....	..	—15°A	....	—12.3	.T]]] I	
100 +	6.	8.5	16.4	..	+0°	....	....	....	....	....	+1	....	..	+0°A	....	+10.8	[[[[T. F (Phemister) II	....
87 —	12.	13.9	16.6	..	—20°	....	....	....	—	5	—1	....	..	—20°A	....	—14.2	.T]] F (Phemister) IV	....

,14 —	10.6	10.8	17.1	..	—25°	—15°	....	—	—	4	—2	—1Q	X	—20°A	....	—13.10	.>T IV	—14
,170 +	7.5	10.5	17.5	+	+5°	....	....	....	+	5	+4½	....	..	+25°A	....	+11.1 —13.11	[[[T. [F .[[[F']]] II	....
,,28 +	10.	12.10	17.5	..	+0°	....	....	....	....	....	....	....	..	+5°A	....	+13.	T[[▶. F— I	+6
,57 +—	12.	14.	17.6	+ —	+20° —30°	....	....	....	+ —	14	....	....	X X	+10°A —20°A	....	+14.11 —14.11	[[F'.F']] [[T T]] III III	....
,30 +—	14.	17.8	18.1	+ —	+0° —0°	....	....	....	....	....	....	....	..	+0°A —0°A	....	+17.8 —17.8	T[[[▶.◀]]T F— —F I I	+6 —6
,,44 +	13.	13.4	19.1	..	+10°	....	....	....	....	2	+1	....	..	+15°A	....	+13.5	[[[T. II	....
,155 +	14.	14.4	19.2	..	+5°	....	....	....	....	4½	....	+1Q	..	+8°A	....	+17.2	T[≪]. from Crista Iliaca I	+12
,4 +	12.	12.2	19.3	..	+5°	....	....	....	....	4	....	....	..	+5°A	....	+12.3	FT. (Phemister) I	....
,86 +	14.	15.6	19.4	..	+25°	....	+15°	....	+	4	+1	....	X	+20°A	....	+15.6	[[[T. F (Phemister) IV	....

1	2 — AGE			3 — CLINICAL EXAMINATION										4 —	5 — TREATMENT			
	2^1	2^2	2^3	3^1	3^2	3^3	3^4	3^5	3^6	3^7	3^8	3^9	3^{10}	Radio-graphy	5^1	5^2	5^3	5^4
58 +	13.	13.10	19.6	..	+0°	....	....	....	....	3	....	....	X	+10°A	....	+14.2	T♂▶. f— I	+8
23 +—	6.	15.10	19.9	..	+20° —20°	....	+20° —20°	....	....	8	....	....	..	+16°A —16°A	....	+17.1 —17.1	[[F'.F']] [[T .T]] F .F (Phemister) III III	....
177 +—	11.	14.9	19.9	..	+10° —10°	....	....	....	....	3½	....	....	..	+10°A —10°A	....	+14.10 —14.10	[[[T.T]] I I	....
174	12.	16.6	20.5	—	—20° ◡	....	....	....	....	10 ◡	—2	—4Q —10C	..	—0°A	....	—16.10	.◀]]T (Complication) IV	—2 days
107 —	14.	14.	21.	.	—0°	....	....	....	....	....	—1	....	..	—10°A	—II	....	.....	....
64 —	10.	10.3	21.3	—	—10°	....	—10°	....	....	4	—1	....	X	—10°A	—II	....	.....	....
104 —	10.11	11.4	23.6	—	—5°	—25°	....	....	....	7	—3	....	X	—20°A	....	—11.9	.◀T —F	—8
																—15.9	.>T —F	—10
																—18.8	.♂◀♂T IV	—8
171 +	13.6	13.8	23.8	+	+15°	....	....	....	....	7½	+1½	+1½Q	..	+ ? A	+IV	....	....	....

,, 156 —	11.8	12.8	24.1	..	—5°	....	....	....	....	5	—2	—½Q	..	—10°A	....	—12.8		·◀T —F II	—6
,, 130 —	13.	13.5	24.3	..	—0°	—10°	....	....	....	2½	—1	....	..	—10°A	—II	....		.....	....
, 34 —	9.	10.3	26.3	—	—0°	....	....	....	....	....	—3	—2Q	X	—7°A	....	—15.5		·◀]T —F II	—14
, 172 +—	8.	25.9	27.11	..	+0° —0°	....	....	....	....	....	....	....	..	+0°A —0°A	....	+27. —27.2	T[▶·◀]T F— I	—F I	+10 —10 days
, 70 +—	13.	19.6	33.3	..	+45° —45°	....	+20° —25°	—	+ —	13	—2	....	X	+10°A —15°A	+III —IV	....		.....	....
,, 63 —	10.	15.	40.2	..	—20°	....	....	—	—	4	—2	—2Q —2C	X	—22°A	—IV	....		.....	....
,, 157 +	13.	32.10	42.9	+	+0°	....	....	....	....	2	+2½	+1Q	..	+5°A	....	+32.10	T[◀]· F— II		+10
, 72 —	14.	16.9	48.2	—	—30°	....	—20°	—	....	....	—2	—2Q —1C	..	—20°A	—IV	....		.....	....
,, 3	12.	58.6	60.	—	—25°	....	....	....	....	8	—1	—2Q —1C	..	—30°A	....	—58.6		.>T filled —f with knochen span. IV	—12

B. Classification of world literature on Mb. Blount

Year	Author	Country	Diagnosis	Mb. BLOUNT			
				Full report	Unsufficient	No radiographi exam.	Not Mb. BLOUNT
1899	KIRMISSON	France	Anomalies de developpement du squelette.				1
1922	ERLACHER	Austria	Deformierende prozesse der epiphysengegend bei kindern.	1			
1922	VALENTIN	Germany	Multipler epiphysenstörung.				1
1922	Mc CURDY	U.S.A.	Rare form of bone lesion.		1		
1924	MAU	Germany	Genu varum bedingt durch tibia-epiphysendefakt bei kartilaginärer exostose.	1			
1928	LANGENSKIÖLD-F	Finland	Leidens in der oberen tibia-epiphyse.	1			
1929	NILSONNE	Sweden	Genu varum mit eigentümlichen epiphysenveränderungen.	2			
1929	RALL	Esthonia	Osteochondropathia deformans juvenilis.	1			
1929	LEWIN and RITTER	U.S.A.	Epiphysis, their growth, development, injuries and diseases.	1			
1930	ROCHER and ROUDIL	France	Genu varum droit ostéogénique par hemiatrophie congenitale de l'epiphyse tibiale supérieure.	1			
1931	LÜLSDORF	Germany	Epiphysitis tibiae deformans.	2			
1932	MASELLI (Valgus')	Italy	Epifisitedeformante tibiale giovanile in ginocchio val.				(2)
1932	GICKLER	Germany	Wachstumsstürungen der tibia-epiphyse.				2
1933	VAN GELDEREN	Holland	Een afwijking in de bovenste epiphyselijn van de tibia.				1
1934	RALL	Esthonia	Genu vara wegen deformierung der tibiaepiphyse.	1			
1936	SLOANE et al	U.S.A.	Dyschondroplastic bow legs.	3			
1937	BLOUNT	U.S.A.	Tibia vara - osteochondrosis deformans tibiae.	7	6		

OBS' no more details about the other cases (i.e about treatment).

Sex		Side			Age	Conservative treatment	Operative treatment	Results
♂	♀	Right	Bilateral	Left				
	1			1	13 Y.	—	—	—
	1			1	2.5 Y.	—	Osteotomy-curved at 2 Y 5 M.	?
	1			1	7 Y.	—	—	—
?	?		1		?	?	?	?
	1	1			6 Y.	—	Osteotomy-curved at 6 Y.	?
1		1			11 Y.	—	Osteotomy-sliding at 11 Y.	?
1	1		1	1	7 & 8 Y.	? —	— Osteotomy-subcondyl at 7 Y. — bil.	? ?
	1		1		8 Y.	—	Osteotomy-bil. at 8 Y.	Recurrence after 9 M.
	1		1		7 Y.	— Without treatment	Osteotomy-unilateral —	Recurrence. Normal.
	1	1			10 Y.	—	Osteotomy at 8 & 9 Y.	Recurrence.
	2			2	9 & 12 Y.	Plaster bandage.	—	?
(2)		(2)						
2		1		1				
	1			1				
	1		1		2 Y.	?	?	?
	3	1	2		4—7 Y.	?	?	?
3	10	2	4	7	3.5—29 Y.	—	Osteotomy-bil. at 4 Y.	?
						Braces-bil. at 2 Y.	—	Good on right at 29 Y.
						—	Osteotomy-uni. at 9 Y.	Good after one year.
						—	Osteotomy-left at 11 Y 5 M.	Good after 6 M.

Year	Author	Country	Diagnosis	Mb. BLOUNT			
				Full report	Unsufficient	No radiographi. exam.	Not Mb. BLOUNT
1937	POUZET	France	Tibia varum.			2	
1939	BARBER	U.S.A.	Osteochondrosis deformans tibia.	1			3
1939	PASCAU	Cuba	Tibia vara.	2			1
1939	PITZEN and MARQUART	Germany	O-beinbildung durch umschriebene epiphyenwachstumsstörung.	4		1	
1939	SIEGLING and GILLESPIE	U.S.A.	Adolescent tibia vara.	1			
1939	BARROS LIMA	Brasilian	Epifisite deformante da tibia.			1	
1940	BIEZINS	Latvia	Subepifizarais osteochondrits.		5		
1942	BARBER	U.S.A.	Osteochondrosis deformans tibiae, (Nonrachitic bow leg in children).	1			1
1942	BLOUNT	U.S.A.	(Abstract)			1	
1942	SWART	U.S.A.	(Abstract)			1	
1945-46	RENANDER	Sweden	Genu varum in children.	1			
1946	LAMY and WEISSMAN	France	Tibia vara.	2			
1946	de CARVALHO	Brasilian	Osteocondrose deformante da tibia na 1° infancia.	1			
1946*	LEONARD and COHEN	U.S.A.	Non rachitic bowlegs in childhood.				6
1948	MORRIS	England	Tibia vara.	1			
1948	SIMON	Hungary	Tibia vara "epiphysarea".	1			

Sex		Side			Age	Conservative treatment	Operative treatment	Results
♂	♀	Right	Bilateral	Left				
						—	Osteotomy-left at 12.5 Y.	Partially recurred after 2 Y.
						—	Osteotomy-left at 14 Y.	Good after 2 Y.
1	1		1	1	14 & 9 Y.	—	Wedge-osteotomy-bil. at 14 Y.	Recurrence.
						—	Osteotomy-left at 9 Y.	Recurrence.
3	1		3	1	10 Y.	—	Osteotomy at 10 Y.	No recurrence after 4½ M.
1	2		1+1	1	12 Y.	—	Wedge-osteotomy-left at 12 Y.	Full correction after 7 M.
							Wedge-osteotomy-bil. at 12 Y.	?
1	4	3	2		5—29 Y.	?	?	5 Y. ?
							Osteotomy-right at 11 Y.	?
							Osteotomy-bil. at 12 Y.	Recurrence.
							Osteotomy-right 12 Y.	Recurrence.
						?	?	29 Y-bil. ?
	1			1	10 Y.	Ambulation prohibited, weight-reduction.	—	?
	1			1	10 Y.		Wedge-osteotomy-left at 10 Y.	?
?	?		5		2—11 Y.	?	?	?
1+1			1+1		5 Y.	Bed rest, physical therapy, wedge-plaster, braces.	—	?
?	?		1		2 Y.	Wedged cast.	—	Improved.
	1	?		?	5 Y.	—	Wedge-osteotomi at 5 Y. — Unilat.	Good: 3 M after op.
1			1		2½ Y.	—	—	?
1	1	1		1	12 Y.	Special apparatus.	—	Gets worse.
						?	?	?
1				1	6 Y.	—	Osteotomy.	?
2	4		6					
	1			1	7 Y.	?	?	?
1				1	3 Y.	?	?	?

Year	Author	Country	Diagnosis	Mb. BLOUNT			
				Full report	Unsufficient	No radio-graphi exam.	Not Mb. BLOUNT
1948	GAMBIER	Italy	Ginocchio varo tibiale.	2			
1949	JACOBSON	Sweden	Jambes arquées non rachitiques chez l'enfant.				3
1950	LASSERRE and LASSERRE	France	Ostéochondrose déformante du tibia (tibia vara, maladie de BLOUNT.			1	
1951	MARIE and MARLAND	France	Jambes arqueés non raquitiques-(syndrome de BLOUNT).				2
1952	LANGENSKIÖLD A.	Finland	Tibia vara (osteochondrosis deformas tibiae).	12		11	
1954	STEMPFEL	U.S.A.	Nonrachitic bowing of the tibia.				9
1955	DAHLE	Norway	Osteochondrosis deformans tibiae, tibia vara, Blount's sjukdom.			1	
1955	ALVIK	Norway	Osteochondrosis deformans tibiae, tibia vara, Blount's sjukdom.			9	
1955	DE PALMA	U.S.A.	Lesions of thes knee in childhood.		2		
1956	ABERLE-HORSTENEGG	Austria	Tibia vara.	2	1	2	
1956	GAILEY	U.S.A.	Osteochondrosis deformans tibiae, tibia vara or BLOUNT's disease.			22	
1957	TOBIN	U.S.A.	Familial osteochondritis dissecans with associated tibia vara.	3			
1957	EVENSEN and STEFFENSEN	Norway	Tibia vara (osteochondrosis deformans tibiae.	2			1
1958	SCHIFF	Germany	Nicht-rachitische O-beine beim kleinkind.				2
1959	PICHON	Morocco	Maladie de Blount.				1

Sex		Side			Age	Conservative treatment	Operative treatment	Results
♂	♀	Right	Bilateral	Left				
	2			2	14 & 9 Y.	—	Wedge-osteotomy.	?
						—	Wedge-osteotomy.	?
2	1		3					
?	?		1		18 months	?	?	?
?	?		2					
7	16	3	12	8	2.5—13 Y.	—	Osteotomy in 13 knees at age 2—6 years.	Good.
							Osteotomy in 6 knees at age 9—11 years.	Not satisfactory.
							Osteotomy in 4 knees at 8—13.	Shortening.
?	?	?	?	?				
?	?		1		?	—	Osteotomy-bil. Age: ?	Very good: left, mild varus right.
?	?	?	?	?	?	3: no treatment.	6: osteotomy.	All: very good.
?	?	?	?	?	?	?	?	?
	5		5		4—45 Y.	Anterior "Spreizskål" at 16 M.	—	Straight at 3 Y 7 M.
						Bandage at 14 M.	—	?
						Bandage at 4 Y.	—	?
						—	Operation in 2 cases at 21 & 45 Y.	?
?	?	?	?	?	?	—	Osteotomy in many (?):	Satisfactory.
						—	Stapling in 2 pat.	Successful.
3		1	1	1	?	?	?	?
1	2		3		7 & 5 Y.	—	Osteotomy-right at 7 Y.	Recurrence.
						No treatment-5 Y. bil.	—	Decline of varus at 12 Y.
?	?		2					
?	?	?	?	?				

Year	Author	Country	Diagnosis	Mb. BLOUNT			
				Full report	Unsufficient	No radio-graphi. exam.	Not Mb. BLOUNT
1959	MICHAIL, et al.	Greece	Osteochondrose déformante du tibia ou maladie d'ERLACHER-BLOUNT (TIBIA-VARA).	8			1
	No more comment on the other 2 cases.						
1959	HERRARA	Spain	Enfermedad de BLOUNT.	2			1
1959	De MORAES and PERRICONE	Brasilian-Italy.	Tibia vara (genu varum par osteochondrose tibiale).	13		21	
	No more special comment on the other 11 cases.						
1959	GIACCAI	Libanon	Osteocondrosi deformante della tibia (Malattia di Blount).	2			
1960	ROJAS et al	Mexico	Osteocondrosis deformante de la tibia. Sindrome de BLOUNT-BARBER.	1	1		
1963	SHTURM No more comment on the other 5 cases.	U.S.S.R.	Deforming osteochondrosis of the tibia.	1		8	
1963	NECHOLODOVA and ARENBERG	U.S.S.R.	Osteochondrosis deformans (Tibia vara).	1		4	
1963	GOLDING and McNEIL SMITH No specification about the number of osteotomies or the age. It is a mixed report.	Jamaica	Tibia vara.	3		25	

Sex		Side			Age	Conservative treatment	Operative treatment	Results
♂	♀	Right	Bilateral	Left				
5	4	1	1+5	2	27 M—13 Y.	—	Osteotomy-bil. at 4 Y.	Correction of recurvatum 2 years later.
						—	Operation? bil. at 13 Y.	Favourable.
						—	Osteotomy-bil. at 3 Y.	?
						—	Osteotomy-right at 9 Y.	Worse.
						—	Osteotomy-bil. at 5 Y.	?
						Plaster bandage left.	—	?
2	1		3		4 & 4 Y.	?	?	?
						?	?	?
18	16	3	25	6	5—50 Y.	Bandage.	—	?
						Forced correction.	—	?
						—	Plaster: recurrence, Osteotomy-bil.	?
						—	Osteotomy in 20 cases. The exact age is not specified!	3: recurrence 6: normal 11: ? ? ?
	2		2		2 Y & 4 M.	Konservative.	—	Unchanged 6 M later.
					2 Y & 3 M.	—	Osteotomy-bil. at 2 Y & 3 M.	Good just after osteotomy.
	1		1		3.5 Y.	Elevation of the feet-internal edge.	—	?
	9	4	4	1	?	—	Osteotomy: in 4 children.	Without recurrence.
	5	?	1+?	?	?	—	Osteotomy: ?	Good.
					?	—	Osteotomy: ?	Recurrence.
					?	?	?	?
					?	?	?	?
					?	?	?	?
17	11		23	5	?	—	Osteotomy: before 6 Y.	Cure.
					?	—	Osteotomy: before 6 Y.	Recurrence.
					?	—	Osteotomy: before 6 Y.	Recurrence.
					?	—	Osteotomy: before 6 Y.	Recurrence.

Year	Author	Country	Diagnosis	Mb. BLOUNT			
				Full report	Unsufficient	No radiographi exam.	Not Mb. BLOUNT
1964	MEDBÖ No specification about the results in the remaining 7 cases.	Norway	Tibia vara (Osteochondrosis deformans tibiae or Blount's disease.).	3		14	
1964	LANGENSKIÖLD and RISKA (71 cases: but 23 cases had already been published 1952) — it is a mixed report. 31 cases bilateral and 40 cases unilateral (no specification of side).	Finland	Tibia vara (Osteochondrosis deformas tibiae).	13		35	
1965	SELIVANOV	U.S.S.R.	Osteochondrosis deformans of the tibia.	1			
1965	MARION and FISCHER	France	Osteochondrose tibiale déformante bilatérale avec tibia varus (maladie de BLOUNT).	1			
1966	BLOUNT	U.S.A.	Tibia vara, osteochondrosis deformans tibiae.	4			

Sex		Side			Age	Conservative treatment	Operative treatment	Results
♂	♀	Right	Bilateral	Left				
1	16	2	13	2	3—9 Y.	—	Osteotomy in all 17 cases. Wedge in majority, while in few also resection from fibula.	2 cases: completly satisfactory (op. at 3—4 Y). 5 cases: satisfactory (op. at 4—6 Y). 3 cases: not completly satisfactory (op. at 8—9 Y).
?	?	?	31	?	1—21 Y.		INFANTILE: 80 knees 44 osteotomies at age: 2—8 Y.	Cured.
							3 osteotomies at age after 8 Y.	Straight.
							11 osteotomies at age before 8 Y.	Recurrence.
							22 (1 st. osteotomy) at 8 to about 14 Y.	Recurrence.
							Those with combined osteotomy and phemister-epiphyseodes (9) & those reoperated later with osteotomy (12).	No varus. Cured.
						In 2 cases:	— — — — — — — —	Spontan-straightening.
							ADOLESCENT: 11 knees	
							10 osteoromies at age: 10—18.5 Y.	Shortening i all & straight in 8 knees — in which 2 of them combined with epiphyseodes-phemister.
						1 knee: no treatment.		
						Nothing was said about result of the remaining 11 knees.		
?	?		1		5 Y.	—	Osteotomy-bil. at 5 Y.	Healed-normal.
	1		1		6 Y.	—	Osteotomy-bil. at 6 Y.	?
2	2	1	3		3—15 Y.	—	Osteotomy-right at 20 months.	Right tibia is 4 mm longer: at 4 Y.
						—	Osteotomy-bil. at 14 Y.	Corrected-bil.
						No treatment-18 M.	—	Restoration bil. at 15 Y.
						Braces-at 20 M.	-	Straight-bil. at 3 Y.

Year	Author	Country	Diagnosis	Mb. BLOUNT			
				Full report	Unsufficient	No radio-graphi. exam.	Not Mb. BLOUNT
1966	BATESON (50 cases: mixed-both severe bow legs and BLOUNT's disease.).	Jamaica	Non-rachitic bow leg.	4		?? 46 ??	
1966	IANNACCONE and PIERAGOSTINI	Italy	La (Malattia di Blount), tibia vara o. osteocondrosi deformante della tibia.	2			
1967	PAPPAS	U.S.A.	Osteochondrosis.		2		
1967	CAFFEY	U.S.A.	Blount's disease.		3		2
1967	ZHITNITSKII et al	U.S.S.R.	Blount's disease or tibia vara.	3		10	
1967	SEVASTIKOGLOU and ERIKSSON	Sweden	Familial infantile osteochondrosis deformans tibiae. Idiopathic tibia vara.	4			
1968	MILIUTINA	U.S.S.R.	Erlacher-Blount disease.		1	34	
1968	BATESON	Jamaica	Blount's disease.		5		
1969	KUROWSKA	Poland	Deforming osteochondrosis of the medial tibial condylus (Blount's disease).	1			
1970	KESSEL	England	Tibia vara.	2			
1970	STØREN	Norway	Blount's disease.	1			
1970	FAIT and SAIBERT	Tjeckoslova-kien	Tibia vara (M. Blounti).	2		11	

Sex		Side			Age	Conservative treatment	Operative treatment	Results
♂	♀	Right	Bilateral	Left				
2+?	1+?		3	1	3—4 Y.	No treatment.	—	Varus-right at 4 Y.
						?	?	?
						?	?	?
						No treatment.	—	Spontaneous recovery-bil.
1	1		2		5 & 6 Y.	Vitaminer and calcium.	?	?
						Vit-D and Ca.+ metal braces.	—	?
?	?	1	1		?	?	?	?
						?	?	?
?	2	?	1	?	2—7 Y.	? ? ?	? ? ?	? ? ?
4	9	1	9	3	?	?	?	?
3	1		4		7—12 Y.		Osteotomy-bil. at 7 Y.	Satisfactory 3 M later.
							Osteotomy-bil. at 7 Y.	Satisfactory 3 M later.
							Osteotomy-right at 4 Y+osteotomy and Phemister-epifyseodesis left & right epifyse at 12 Y.	Satisfactory 2 Y later.
						No treatment.	—	Slight varus.
5	30	?	?	?	22 M—16 Y.	?	?	?
1+?	3+?	2	1	2	?	?	?	?
	1		1		4 Y.	?	?	?
	2		2		3—4 Y.	—	Forage-bil. at 2 Y and 9 M.	Straight at 4 Y and 2 M.
						—	Forage-bil. at 2 Y and 3 M.	Virtually normal at 3 Y and 3 M.
	1	1			36 Y.	—	2 Osteotomies at 8 Y and 12 Y+op. — elevation of the medial tibial joint — at 13 Y.	Recurrence. No varus at 36 Y.
1	12	?	?	?	2—6 Y.	—	Osteotomy: 9 children at age: 2—6 Y.	Improved.
							Osteotomy: 3 children at 2—6 Y.	Reoperation.
						2 children (?): no treatment.		Spontaneous improvement.

Year	Author	Country	Diagnosis	Mb. BLOUNT			
				Full report	Unsufficient	No radio-graphi exam.	Not Mb. BLOUNT
1970	SIFFERT and KATZ	U.S.A.	Osteochondrosis deformans tibiae.	2		3	
1970	LOVEJOY and LOVELL	U.S.A.	Adolescent tibia vara.	2			
1970	SAZONOVA	U.S.S.R.	Erlacher-Blount disease.				1
			TOTAL	133	27	217	41

Sex		Side			Age	Conservative treatment	treatment Operative	Results
♂	♀	Right	Bilateral	Left				
2	3		3	2	5—9 Y.	—	Osteotomy-bil. at 8 Y +reosteotomy-right at 9 Y.	Recurrence on the right.
							Osteotomy-left at 5 Y +reosteotomy at 9 Y.	Recurrence.
							Osteotomy-left at 5 Y.	Recurrence.
							Osteotomy-bil. at 5 Y.	Recurrence.
							Osteotomy-bil. at 9 Y.	?
2		2			11 & 14 Y.	—	Osteotomy-right at 6 Y +left subtrochanteric fem. osteotomy — (slipped epiphys.+pinning right femoral epiphys.).	?
							Osteotomy-right at 14 Y+pinning both femoral epiphys. (slipped).	?
	1		1					
88 +?	193 +?	32 +?	186 +?	64 +?				

Only cases of Mb. Blount were counted.

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SYMBOLS AND ABBREVIATIONS

1 — Case number.
Sex: ' male, '' female.
Side: + right, — left, +— bilateral. The ∩ means that the side belongs to the physiological type of genu varum and not Mb. Blount.

2 — The age of the patient:
2^1: when varus deformity was detected.
2^2: at first clinical examination.
2^3: at last examination.
The figures represent: years . months.

3 — Clinical findings at last examination:
3^1: Signs: such as pain in the knee or tiredness on exertion during the course of the disease.
3^2: The degree of varus deformity on standing, while valgus deformity is indicated by ∪.
3^3: The degree of recurvatum on standing.
3^4: The internal rotation, either simply mentioned or specified in degrees.
3^5: There is abnormal mobility of the knee on medial strain, but normal lateral stability.
3^6: Limping: + right sided, — left sided, or waddling $\pm$.
3^7: The distance in cm. between the medial knee-spaces in standing position with both feet together. The ∪ indicates the distance in cm. between the two medial malleoli in cases with valgus deformity.
3^8: Leg shortening in cm. + right side, — left side.
3^9: Quadriceps atrophy in cm. measured 10—15 cm. above the patella Q, while C means atrophy in cm. of the calf (the largest).
3^{10}: The existence of flat feet X with varying degrees of valgus up to 30°.
. . . . means nothing remarkable (normal).

4 — Radiography: the degree of FEMUR-epiphysis-TIBIA-diaphysis (angle 5), at last examination. The appearance of radiography is indicated as: P = physiologic genu varum, M = metaphyseal stage, E = epiphyseal stage, J = juvenile type, A = adult, and N = normal. . . . . means, radiography was not available at last examination.

5 — The treatment:
5^1: Non-operated knees with end-results: I, II, III, IV.
5^2: Age at the time of operation. The figures represent: years . months.
5^3: Operated knees:
Site of operation: T = proximal tibia. f = distal fibula.
F = proximal fibula. F'= distal femur.

Type of operation: [= epiphyseodesis with stapling.
▶ = wedge osteotomy.
> = medial open angle, possibly filled with bone chips.
⋘ = medial open angle filled with the wedge.
— = transverse osteotomy.

Fixation of the osteotomy: ▌ = plate.
[= staple.
♂ = wire.
⫻ = screw.
❜ = pin.

The end-results: I, II, III, IV.

With registration, the right side mentioned first and then the left side.

5^4: Fixation with plaster of paris, the figures represent number of weeks. + right side, — left side.